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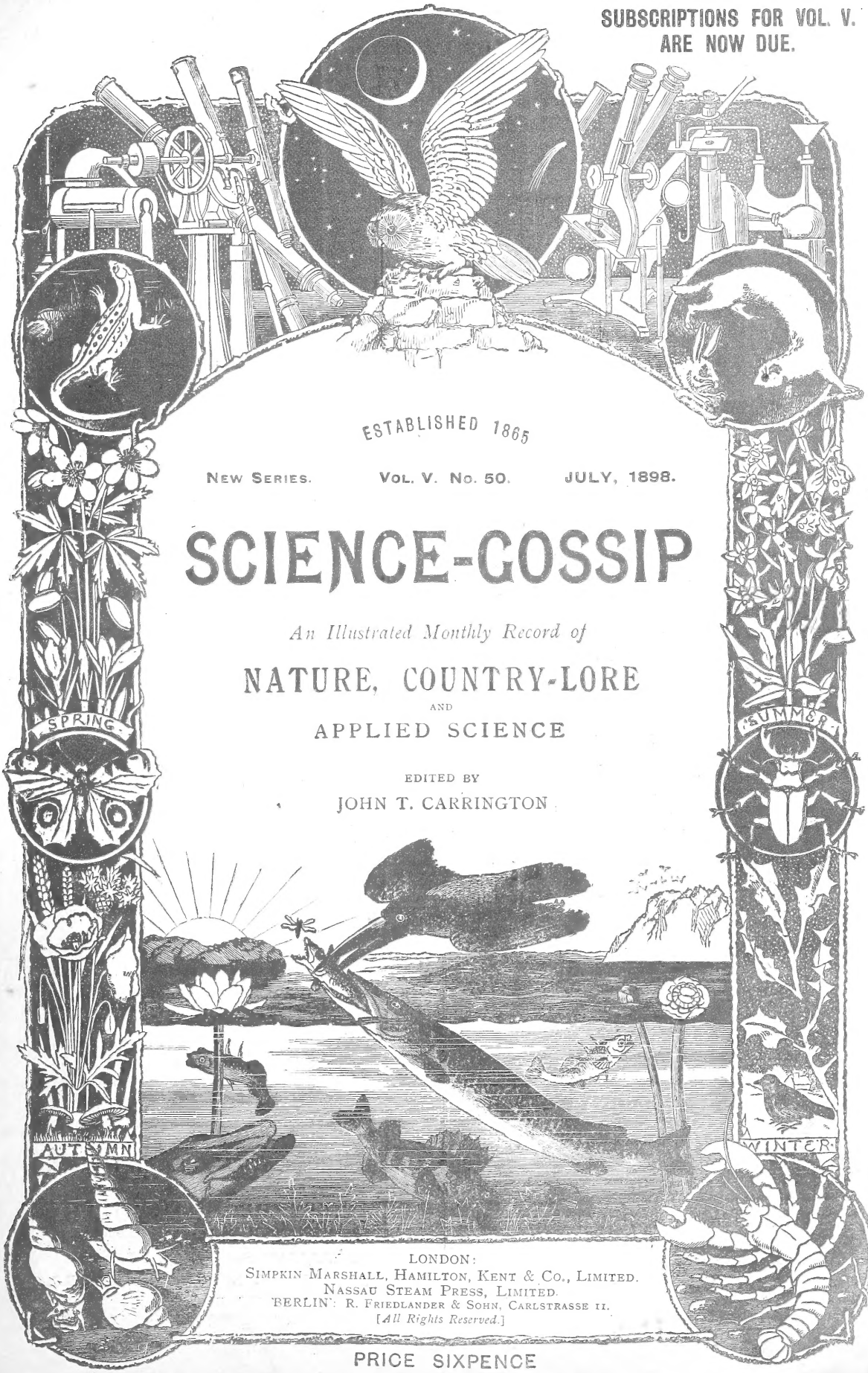

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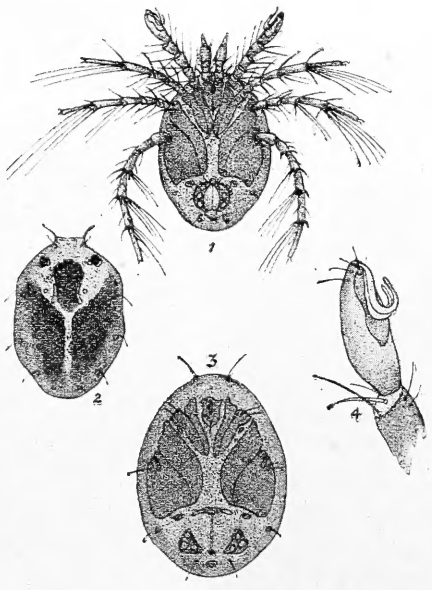
BRITISH FRESHWATER MITES.

A SPECIES NEW TO BRITAIN.

By C. F. George, M.R.C.S.

Wettina macroplica Piersig is a pretty and curious little mite which appears to have escaped the observation of the older writers on the Hydrachnidae. Piersig seems to have first found it, for he described it in 1892 in "Zoologischer Anzeiger." In his large and important work ("Deutschlands Hydrachniden") now in course of publication, he gives a coloured figure of the dorsal side of the female, a ventral and dorsal figure, uncoloured, and a figure of the ventral side of the larva and nymph, as well as a figure of the palpi; but he does not figure the ventral side of the male. I first found the male in October, 1895, and it was only this spring that I found the female. The sexes are very much alike in appearance at first sight, excepting as to size; the female, as is usual in water mites, being considerably the larger.



Wettina macroplica *Piersig.*

Fig. 1.—Ventral side of male. Fig. 3.—Ventral side of female
„ 2.—Dorsal „ „ „ 4.—Last joint of first leg.

The general colour of *Wettina macroplica* is pale dull yellow, with dark reddy brown caeca, looking almost black when only slightly magnified. The Y-shaped portion, between the caeca, is of a deeper and brighter yellow. The creature is a very good and active swimmer, and gyrates in a curious fashion, somewhat after the manner of some of the smaller male *Curvipes*. The swimming-hairs on the front legs are rather strong and curved, thickest at their base and gradually tapering to a point at the apex. The mite, after being disturbed, swims only for a short time, and soon buries itself again in the mud, and this may be one reason why it has been seldom noticed. One of the features that first strikes the observer is the curiously enlarged last joint of the first pair of legs, with their tremendous claws, which can be quite retracted into a cavity; the female possesses them as well as the male. The last two or three joints of all the legs are more or less coloured a yellowish red; this is the case in some other mites, especially in *Acercus* and *Curvipes*. These also have, in some species, the ultimate joint of the first pair of legs enlarged, but in their case the end joints of the second pair of legs have likewise been enlarged in such specimens as I have observed. The anterior portion of *Wettina macroplica*, especially in the male, has a sort of neck, from each corner of which, or rather from a slight tubercle under each corner, projects a rather long tactile hair, curving outwards. The genital area at once serves to distinguish this mite from *Acercus* or *Curvipes*, for there are only three cells, or discs, placed on chitinous plates on each side of the sexual opening, and these are differently arranged in the sexes. In the male the plates surround the sexual opening, and have the cells on them after the fashion of some *Limnesia*; in the female the plates have the cells arranged on them in a sort of triangle and are situated at the posterior part on each side of the sexual opening, as in *Piona*. All this is well shown in the figures so kindly drawn for me by Mr. C. D. Soar.

So far as I know, no other species of this genus has yet been described. The following are its diagnostic characters:—(1) The three basal joints of the first pair of legs are *not* thicker than the others; (2) the body skin is soft, not chitinous; (3) the fourth pair of legs are provided with claws; (4) the thigh plates are divided into four groups; (5) the genital discs are three in number and placed on chitinous plates; (6) the palpi are not so long as the body; (7) the first pair of legs have the distal end thickened and provided with large claws.

Kirton in Lindsey.

AN INGENIOUS GLACIATION THEORY.

By G. W. Bulman, M.A., B.Sc.

OF the many attempts to account for the Glacial period which have been put forward at various times, none have hitherto been able to stand the strain of adverse criticism. Yet of glacial theories, as of Virgil's golden bough, it may be said, "Primo avulso, non deficit alter," and the hypothesis set forth by Mr. Marsden Manson, C.E., in a paper read before the Technical Society of the Pacific Coast (1), seems worthy of attentive consideration. In brief outline the hypothesis is as follows.

At some point of its past history as a cooling body, the earth must have possessed a surface heat of 212° F., or upwards. Water could not at that temperature remain as liquid on the surface, but would form a dense cloud above it. In the upper parts this vapour would condense, and fall as rain; but so long as the temperature remained near 212°, it would be immediately driven off again as vapour. Thus the greater part of the terrestrial water substance would exist as a vapour screen; and this screen, so *immensely greater* than our present cloud envelope, it is supposed, would effectually prevent the loss of earth heat, and exclude solar rays. Consequently the climates of the earth, instead of being under the control of solar heat as at present, would depend on earth heat alone. As a consequence of this, a uniform climate would prevail from the poles to the equator. In this way the theory accounts satisfactorily for the geological fact of the remarkable uniformity of climate in past ages.

Mr. Manson enunciates his theory as follows, in the form of a proposition, which he afterwards proceeds to prove: "Given a heated globe, constituted and circumstanced as the earth, and whose surface temperatures, by reason of internal heat, are above the boiling-point of water, to prove that before its surface temperature can pass under the control of solar heat the continental areas must be glaciated."

The climate of a globe thus circumstanced would be entirely independent of solar heat, for the thick screen of vapour would effectually prevent the solar rays from reaching it. At the same time, its own heat would pass through such a screen so slowly, that its temperature would be retained at 212°, or upwards, for long ages. Further, the sun's rays, by heating the upper layer of this vapour screen, would likewise tend to retard the cooling of the earth. According to Mr. Manson's theory, this temperature must have been retained through the geological epochs up to post-tertiary times. The earth radiating its internal heat equally in all directions, the region of the poles would be as warm as the equator. This is a strong point in the theory, for it thus accounts in a satisfactory way for the remarkable fact, above referred to, of the uniformity of climate in the past, as indicated by geology.

It is, however, this very point in the theory which brings it into violent contact with the recent researches of eminent physicists, concerning the secular cooling of the earth. At no period later than 10,000 years from the first solidification of the earth, says Lord Kelvin, could its own internal heat have appreciably affected its climate. If this is so, then obviously the climate of the earth cannot have been under the control of its own heat from Cambrian to the close of Tertiary times, as Mr. Manson supposes. In this connection, however, it may be asked, has Lord Kelvin sufficiently taken into account the retardation to the cooling of the earth which a thick vapour screen would effect?

Granted, then, such a vapour screen, let us consider what would happen as the temperature gradually sank, and solar heat was finally able to reach the earth. In its uppermost layers the cold of space would cause the formation of snow and ice, but as this fell it would pass through the warmer layers, and be melted long ere it reached the earth. By slow and almost imperceptible degrees, during the long geological ages, the snow-line would descend nearer and nearer the earth. At length it would reach it, and snow would begin to accumulate. This would be the inauguration of the Glacial period, and the climate of the whole globe would become arctic. The continued snow-fall and the very small quantity returned from the earth as vapour would gradually clear the atmosphere, and in time the influence of solar heat would make itself felt on the earth. First round the equator the snow would be melted and the climate ameliorated. Water would remain permanently on the earth, and its climate would gradually pass more and more under the control of solar heat as the cloud screen disappeared.

Obviously, according to this theory, there has been only *one great Glacial period*, and hence all evidence of glaciation in Tertiary and Pre-tertiary times is against it. Such evidence has been diligently sought for by advocates of many Glacial epochs, and they claim to have found it. On the whole, however, it cannot be said that such evidence as has been brought forward is as satisfactory as might be desired, or that the question has been decisively settled in favour of many Glacial epochs. Perhaps

(1) "Transactions," vol. viii. No. 2., 1891.

the most striking evidence is that of the Carboniferous ice age in India. For in that formation polished and striated boulders have been found strikingly similar to those of the Great Ice Age.

Before the Glacial period proper, however, Mr. Manson thinks that local glaciation may have taken place on some of the older mountains, to disappear again by the setting free of earth heat by vast fractures of the crust. This, he believes, satisfactorily accounts for apparent Glacial and Interglacial periods in the past. Whether, however, Mr. Manson's theory permits the supposition of a Glacial period so far back as the Carboniferous, appears more than doubtful.

It is evident, again, that according to this theory glaciation must have extended from pole to pole; and the objection is at once apparent, that in the northern hemisphere we have evidence of glaciation only as far south as latitude 50° in Europe, and 40° in North America.

The various conditions of climate while the earth was under the control of its own internal heat were, an era of torrid heat, an era of tropical heat, an era of temperate heat, an era of glacial cold. It was during the era of torrid heat, when the surface temperature had sunk to 90° F., that the luxuriant vegetation of the Carboniferous period appeared and clothed the world from pole to pole. Palaeontology, however, has not shown corresponding changes in the life of the globe. Yet it is contended that the fossil life of deposits below the Permian belongs to an ultra-tropical type, while that of Mesozoic times is tropical in character. While during Tertiary times a temperate climate up to the poles is said to be indicated by the Tertiary fossils of Greenland, Spitzbergen, etc.; glaciation would commence the moment a snow flake reached the earth which its waning heat was unable to melt. Going back to Archaean times, Mr. Manson considers the crystalline character of the rocks proves the high temperature then existing on the earth.

It may be useful here to add Mr. Manson's own recapitulation of his paper. "The objects of this paper are to demonstrate: (1) That in the passage of the earth from an era during which its climates have been controlled by internal heat, into an era during which its climates are controlled by solar heat, a Glacial period must intervene. (2) That the direct cause of the Glacial period was a combination of the remarkable properties, in relation to heat and cold, possessed by the various forms of water: as *vapour*, it prevented the loss or receipt of heat by radiation; as *water*, by reason of its high specific heat, it retained to the last moment the effective remnant of earth heat; as *ice*, it assumed a solid form, storing the maximum amount of cold. (3) That through all geological time to the culmination of the Glacial period, solar heat was only conservative of earth heat."

29, *Queen's Terrace, Jesmond, Newcastle-on-Tyne.*

LANCASHIRE COAST MOSSES.

By J. A. Wheldon.

SPRING is not the best time of the year for the botanist to visit the Lancashire sand-dunes; but I had promised Messrs. Dixon and Bonlay additional specimens of an apparently new variety of *Hypnum aduncum*, which I found there last autumn; therefore, on a gloriously fresh May morning I set forth with my son in search of a further supply of the novelty. *En route* we passed the new Lancashire locality for *Catharinea undulata* var. *hausknechtii* Dixon. We succeeded in finding a few old capsules still persisting, their setae having become lateral through lengthening of the axis by means of innovations near the apex. An adjacent pond was white with abundance of *Ranunculus aquatilis*, relieved by an occasional patch of yellow *Caltha palustris*, the shallower margins being choked with a tall floating form of *Hypnum riparium*. This is a most protean moss, which sometimes simulates a humble creeping *Brachythecium*, and anon resembles a huge *Fontinalis* or one of the harpidioid forms of *Hypnum*.

Not far from this pool is a station for *Cochlearia danica*. It has been asserted that this species does not occur on the Lancashire coast, but I have found it in some plenty here, and more sparingly to the north of Southport. The Rev. E. F. Linton has kindly examined and verified fresh specimens, thus confirming the opinion previously given by Messrs. Marshall and Beeby from dried examples which I had sent to the Botanical Exchange Club.

From the train which bore us to our destination, we noticed the sand-martins busily excavating the perpendicular walls of a red-sand quarry, and the railway banks were gay with the flowers of *Scilla nutans*, *Lychnis dioica* and *Erysimum alliaria*.

On arrival at Southport we soon deserted the smiling flower-beds of the foreshore for the arid-looking dunes, which were anything but barren to us, as we were speedily surrounded by interesting objects on all sides. Even the loosest drift sand was spangled with the flowers of the dandelion, both the varieties *laevigatum* and *erythrospermum* being equally common, but when the former is waning in glory the latter just attains its maximum

splendour. On similar loose sand, where little else but the marram, sea-spurge and sea-holly will thrive, the lovely little pansy, *Viola curtisii*, was flowering freely, but we only saw the purple flowered form. The yellow variety is usually the commoner here. The dog-violet, *Viola ericetorum*, was still more abundant, but affected the oases amongst the sand-hills, where the rainwater collects and promotes the growth of a certain amount of cover in the form of grasses, dwarf willow and sedges. Amongst the mosses, which were our more especial quest, our first find was *Bryum pendulum*, its dense miniature forest of setae giving a distinctly russet tinge to the hollow in which it grew, contrasting beautifully with the delicate pale green of the drooping unripe capsules. Scattered thinly near, we found *Bryum neodamense;* and *Hypnum polygamum*, as it should do in virtue of its name, was fruiting freely, the capsules being in good condition for gathering. In the immediate vicinity, a station for *Meesia uliginosa* has been destroyed, and we looked for it in vain. Crossing a dense patch of *Scirpus rufus* (also doomed to disappear before the builder) we struck further inland. Then our ears were saluted by a chorus of soft purring notes that seemed to come floating on the air out of space. The cause was soon discovered. At every step swarms of natterjack toads *(Bufo calamita)* with their sombre but gaily-streaked backs, scuttled off to shelter under the damp herbage, their melodious croaking ceasing as soon as they were disturbed. Here we chanced to find a great patch of *Hypnum wilsoni*, but, as usual, there was no fruit. With it were *H. sendtneri* and *H. revolvens*, the former an addition to our Lancashire records. Crossing the newly-made golf-links, the construction of which will, I fear, cause some missing links in the chain of our present florula, we saw *H. lycopodioides*, and my lynx-eyed juvenile companion succeeded in detecting two or three immature capsules. This was followed in rapid succession by interesting finds in *Bryum ventricosum* var. *compactum*, *B. calophyllum*, *B. pallens* and *B. lacustre* (all, unfortunately, with fruit too immature to be collected), *Hypnum serpens* —apparently var. *depauperatum*, in fruit—and the peculiar form of *H. filicinum*, described and figured in SCIENCE-GOSSIP (Vol. ii. N.S., p. 284) as var. *whiteheadii*. My son next brought what he called "very thick *Hypnum cuspidatum*," which I at once recognized to be *H. giganteum*. The cuspidate tips of the branches cause it to closely resemble the former plant when submerged in the pools. In collecting specimens of this I brought up a huge beetle, which I took to be a *Dytiscus*. He was very ferocious, and laid hold of my hand with his mandibles, but without piercing the skin. I returned him to his element, and he promptly dived to the bottom.

After a rest and refreshment we resumed our journey, our first discovery being the moss we had specially come to collect, a form of *Hypnum aduncum* of the group *pseudofluitans*. It is somewhat remarkable that such a handsome and noble form should have been overlooked so long, as it is very abundant. Near it grew *Brachythecium albicans*—now out of fruit—the stunted sand-dune form of *Climacium dendroides* and *Amblyodon dealbatus;* also a little *Camptothecium lutescens*, which is said in the "Liverpool Flora" to clothe the sandhills, but which I have only found in exceedingly small quantity. Retracing our steps a short distance, we found *Cerastium tetrandrum* and *Vicia lathyroides* in flower. Striking inland we resumed our return journey in a parallel line with our earlier route, and found more of the *Hypnum aduncum* variety and of the variety of *H. filicinum* before-mentioned. With these were *H. wilsoni*, on which we detected about half a dozen capsules, *H. cuspidatum* (in fruit), *H. giganteum*, *H. lycopodioides* and *H. wilsoni* var. *hamatum*, the last-named an addition to the Lancashire list. We were now amongst the natterjacks again, and as evening approached they became more clamorous. Before finally leaving the sandhills, my young comrade found *H. elodes* fruiting freely, but the capsules were hardly mature. It had been our intention to visit the north side of Southport for ripe fruit of *Pottia heimii*, but we had already exhausted our time, and very regretfully turned our backs on the sea, after a most enjoyable ramble in perfect weather. I have to express my gratitude to Mr. H. N. Dixon for much critical advice and assistance in determining some of the above-named mosses.

H.M. Prison, Liverpool.

CROYDON CONGRESS.—The annual congress of the South-Eastern Union of Scientific Societies was held on the 2nd, 3rd and 4th of June, at Croydon. The Mayor and Corporation placed the Town Hall at the disposal of the Union. The Mayor also invited the delegates to a reception, which was numerously attended. The presidential address, read by Professor G. S. Boulger, was devoted to a review of the progress of science during the past sixty years. In tracing the rise of enlightened thought from the comparatively dark period of scientific knowledge of the first decades of this century, Professor Boulger had to deal with an attractive subject. The President by no means disappointed his audience, for he told his story with ability. Numerous papers were read at the meetings, and useful discussions took place. A temporary museum was arranged, in which exhibits and photographs were displayed, some being of more or less local character. There were various pleasant excursions on the Saturday afternoon, and visits on other days to the ancient archiepiscopal palace and Whitgift Hospital in Croydon. Next year's congress of the South-Eastern Union is to be held at Rochester. At future meetings of the Union it will be well to shorten the length of some of the papers communicated, and otherwise reduce the work attempted, which will add to the success of the congress.

BRITISH INFUSORIA.

By E. H. J. Schuster, F.Z.S.

Part II.—Flagellata Pantostomata.

(*Continued from page* 11.)

THIS order contains the lowest and least specialized forms of the flagellate Infusoria. The oral aperture is quite indefinite, and in those cases where solid particles of food matter are ingested, any part of the body cavity performs the function of mouth. It is in this way that the ordinal name, Pantostomata, which means animals who are all mouth, is derived. Locomotion is effected, as in the Eustomata, by means of vibratile flagella. Mr. Saville Kent's classification is based on the number of these organs present, and by this means are established three sub-orders, the Monomastiga, the Dimastiga and the Polymastiga. These possess, respectively, one, two and more than two flagella for propulsive purposes.

The most highly organized forms occur in the last section, particularly in the family Lophomonadidae. As these animals are for the most part endoparasitic in habits, I am inclined to believe that the absence of a definite oral aperture is due to degeneration, and that the forms in question are derived from eustomatous species. In this case, of course, they ought not to be included in the order Pantostomata. Among the lower families, the individuals are for the most part irregular and inconstant in shape. The species shade insensibly into one another, and in many cases are probably only developmental phases of other Infusoria spores of algae, etc. Taking these things into consideration, only those species whose life-histories have been thoroughly worked out can be considered as satisfactorily established.

The following are descriptions of some moderately distinct and widely distributed forms. Whether they all deserve specific names of their own or not is an open question. It may be answered by any energetic person who thoroughly investigates the details of their lives.

Sub-Order Monomastiga.

Family Monadidae, Ehrenberg.—"Animalcules naked or illoricate, entirely free-swimming; flagellum single terminal, no distinct oral aperture, an endoplast or nucleus and one or more contractile vacuoles usually present."

Monas varians Dujardin, is exceedingly plastic and variable in form, its most regular contour is oblong, tapering slightly towards the anterior extremity, at which the flagellum has its origin. The body substance is soft and glutinous. A sub-central and spherical nucleus and one contractile vacuole are present. The length is from 32 to 40 microns, the flagellum is about twice as long.

This animal may be found in ditch-water; it

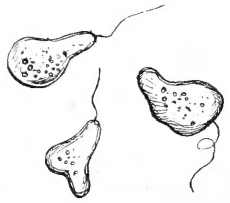


Fig. 13.—*Monas varians* (× 600).
Some of the various shapes which the animal assumes are shown here.

prefers those ditches which have trees overhanging them. It was discovered by Dujardin on November 18th, 1838, in some water which he had kept for eight days after having taken it from a roadside rut on the north side of Paris.

Monas ramulosa Stein, is elongate and subcylindrical in shape; it is widest at the posterior extremity, and conical anteriorly. The peripheral surface is sometimes produced into a number of

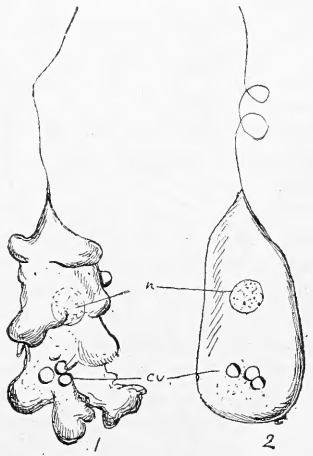


Fig. 14.—*Monas ramulosa* (× 600).
n, nucleus; *cv*, contractile vacuole.
(1) Condition with fingerlike processes protruded; (2) the same without them.

finger-shaped lobes, not entirely unlike the pseudopodia of an Amoeba. The flagellum is about the same length as the body, sometimes a trifle longer, and springs from the anterior end. A

contractile vacuole is situated near the hinder end; it is sometimes single, sometimes subdivided into three or four smaller vacuoles. The nucleus is situated subcentrally. The protoplasm is somewhat granular. This animal is the largest representative of the genus *Monas*, being from 40 to 70 microns in length. It was discovered by Stein, and called by him *Cercomonas ramulosa*. As, however, the genus *Cercomonas* is characterized by a caudal filament which is not present in the species in question, it was transferred by Saville Kent to the genus in which it now stands.

Its habitat is similar to that of the preceding species.

Monas mica Müller, is roughly oval in shape, but like all the other species of the genus it is by no means constant in this respect. The protoplasm is transparent and coarsely granular. It occurs in fresh water, and swims in a slow and oscillating manner, like one which has lost its way. The length of the body is about 15 microns.

the body itself. This sometimes takes the form of a fine filament, scarcely greater in diameter than the flagellum itself; sometimes it is somewhat thicker, and may even take the form of an elongate transparent tail. Dujardin says that it is capable of an undulatory movement. The body of *C. crassicauda* is elongate ovate in shape, and about two and a-half times as long as broad. The caudal filament is usually very thick at the base, and tapers to a fine point at its distal end. In length it is about equal to the body. The anterior flagellum is much finer and longer than the caudal filament. The protoplasm is granular. There are usually two or three contractile vacuoles present, which are situated near the anterior end. The nucleus is subcentral in position. The length of the body is about 24 microns.

This animal may be met with in fresh water and vegetable infusions.

Oikomonas steinii Saville Kent. — The genus *Oikomonas* agrees structurally very closely with

Fig. 15.—*Cercomonas crassicauda* (× 600).

Fig. 16.—*Oikomonas steinii* (× 750).

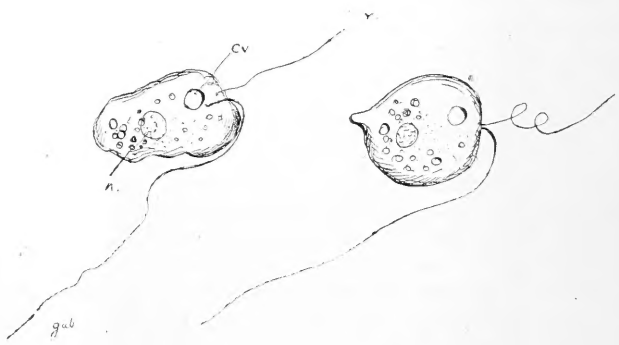


Fig. 17.—*Heteromita ovata* (× 600).
tr, tractellum; *gub*, gubernaculum; *cv*, contractile vacuole; *n*, nucleus.

Monas viridis Dujardin. — The body of this animal is spherical. One half is green, the other is colourless and transparent. The flagellum is long and slender. The length of the animal is 8 to 10 microns. It occurs in fresh water, and is social in habits. About the validity of the species is some considerable doubt. Dujardin says he found a drawing of it in his note-book, but that he would have to see the animal itself again to make quite certain of it. De Fromentel thought fit to retain it in the genus. Saville Kent suggests that it is in reality the motile spore of some alga.

Family Cercomonadidae.—"Animalcules naked, free-swimming or adherent; provided with a permanent or temporarily developed caudal filament; vibratile flagellum single, terminal; no distinct oral aperture."

Cercomonas crassicauda Stein.—The genus *Cercomonas* differs from *Monas* by possessing a posterior prolongation made up of the same substance as

Cercomonas, that is to say that it possesses a plastic and changeable body, which is prolonged posteriorly into a threadlike filament, and anteriorly bears a single flagellum. It differs from *Cercomonas* in the fact that it spends most of its time in a sedentary condition, and it is solely with a view to this condition that the tail is developed. This structure is apparently merely a temporary elongation of the body by which the animal clings to weeds or decaying animal or vegetable matter. During this, the sedentary period of existence, the flagellum is used to sweep food particles within easy reach. *O. steinii* is regularly pear-shaped when situated as before described; but in nomad condition it is quite irregular, being sometimes spheroidal, sometimes ovate, or even elongate. The flagellum undulates throughout, and is equal to the body in length. The contractile vesicle is single and subcentral, and placed just in front of the nucleus. The length is 16 microns.

This animal occurs in vegetable infusions, and is not uncommon in putrid ditch-water.

SUB-ORDER DIMASTIGA.

Family Heteromitidae, "Animalcules naked, free-swimming or temporarily attached. The more anterior appendage, 'tractellum,' locomotive and vibratile; the posterior one, 'gubernaculum,' usually trailing and adherent; no distinct oral aperture."

Heteromita ovata Dujardin.—The body of this animal is ovate, becoming rather narrower towards the anterior. At this end the two flagella, which form the chief characteristic of the genus, are situated. One of these is terminal in origin, the other arises somewhat posterior to it, on the ventral surface. The former is called the tractellum, for by its vibrations the animal is drawn along. The other is called the gubernaculum, or rudder; by it the animal is steered and kept steady when swimming, and it is anchored by it when it comes to rest on some object. In *H. ovata* the tractellum is slender, and about three times the length of the body; the gubernaculum is a trifle longer, and much thicker. The surface of this animal is smooth. The internal protoplasm is granular, and contains an anteriorly situated contractile vacuole. The length is 27 to 35 microns.

This species may be met with among aquatic plants, in river, stream, pond, or ditch-water.

Heteromita globosa Stein. — The body of this animal is somewhat variable in shape; it is usually spheroidal or ellipsoidal. The surface is coarsely granulate. The flagella are arranged as in *H. ovata;* they are almost equal in the length and thickness and are two or three times the length of the body. A single contractile vacuole is present, which is situated close to the centre of the right lateral border. The nucleus is spherical and is placed on the median line towards

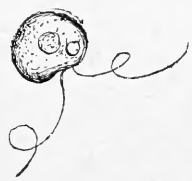


Fig. 18.—*Heteromita globosa* (× 600).

the anterior end. The length of the body is from to 25 microns.

This animal lives in pond-water, and for diet appears to prefer decaying animal matter. Saville Kent came upon a crowd of them which were having a dinner party in the carapace of a dead rotifer. They seemed to consume the delicious contents of this with great gusto, figuratively speaking, even with enjoyment.

Family Bikoecidae. "Animalcules sedentary, ovate, or pyriform, with a usually more or less projecting anterior lip-like prominence, solitary or colonially associated, secreting separate horny sheaths or loricae, which are mostly stalked; flagella terminal, two in number, one long and one short; parenchyma transparent; no distinct oral aperture; endoplast and one or more contractile vacuoles usually conspicuous; increasing by transverse subdivision and by the separation of the body into a mass of sporular elements. Inhabiting fresh and salt water."

Bicosoeca lacustris James Clark.—The body of this animal is ovate, and from its anterior end a lip-like process projects. It lives in a horny lorica and is attached to the bottom of this by a contractile thread. It bears two flagella, one long and more or less conspicuous and the other short and hard to see. When the animal contracts into its sheath, the longer flagellum becomes rolled up into a spiral coil. Two or three contractile

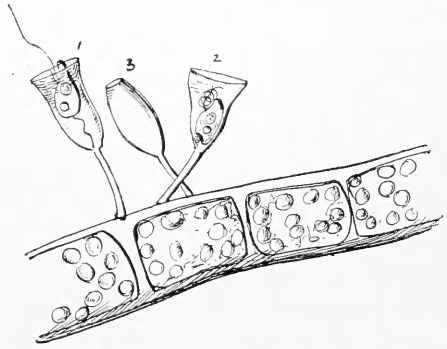


Fig. 19.—*Bicosoeca lacustris* (× 750).
(1) Expanded; (2) contracted; (3) an empty lorica of the typical shape.

vacuoles are placed near the hinder end. More or less in the centre of the body a spherical nucleus may be seen. The lorica is typically ovate, the widest part being near the posterior, but I have met with a variety in which the reverse was the case, and this is here figured. It is supported on a pedicle about equal to it in length. The length of the lorica is about 10 microns.

This animal is abundant and widely distributed, and lives in pond-water.

Dallinger and Drysdale have made careful observations of the life-histories of certain of the Pantostomata, but as the species which they investigated occur for the most part in artificial cultures (such as cod-fish-head tea in an advanced state of decomposition) they hardly come within the limits of an article which is engaged only on natural habitats. As, however, there is no particular reason to suppose that the "Infusoria of the field" have life-histories very different to those of the more domesticated animals of Dallinger and Drysdale, it would not, perhaps, be entirely out of

place to give brief accounts of the bionomics of two species, as worked out admirably by those gentlemen.

On the reproduction of *Monas dallingeri* Saville Kent.—This is an uniflagellate monad obtained in great abundance in an infusion of cod's-head after keeping it for about three months. It was observed to reproduce itself by three separate methods: (1) by an ordinary process of transverse fission; (2) spore formation following on the conjugation and encystment of two individuals. The spores produced are of such a minute size as not to be visible under a $\frac{1}{50}$-inch objective. These two methods by not accounting for the rapidity with which the numbers of the species increased lead to the discovery of the third method. (3) Direct multiple fission. The animal about to divide assumes first a rounded and afterwards an amoebiform contour. In this state the flagellum is absorbed. Two lines of division at right angles to one another were then observed to appear, followed rapidly by various others. A quick interchange of the body substance in the various parts then seemed to take place, lasting from ten to seventy minutes. Then this stopped, and the animal split up into a great number of sausage-shaped bodies. These now began to writhe for a space of from seven to thirty minutes. The whole mass then fell to pieces, and each portion when it became detached presented the appearance of a tiny uniflagellate monad resembling in all characteristics the parent form.

On the reproduction of *Heteromita rostrata* Saville Kent.—The following process of spore-formation following on conjugation is recorded. Under certain circumstances a free-swimming form approaches one which is anchored by its gubernaculum, and completely fuses with it: the nucleus of one unites with the nucleus of the other. In this way an irregular body is formed with two flagella at either end and one central nucleus. For a time this swims about freely, becoming meanwhile triangular in shape. The two pairs of flagella are situated at two corners of the triangle. After a time this zygote loses its nucleus, its protoplasm becoming hyaline and transparent. It then settles down to rest and loses all the flagella. After a period of quiescence it undergoes wavelike contractions of the surface, and bursts at the three angles. Its contents escape in the form of exceedingly minute spores. These increase in size and become oval in shape. The ventral flagellum is first developed, then the anterior end becomes pointed and finally produced into a tractellum.

(*To be continued.*)

PLANTS AND ANIMALS OF DIFFERENT SOILS.

By H. Franklin Parsons, M.D., F.G.S.*

IT must be a circumstance familiar to every field-naturalist or observant lover of nature that different plants are met with on different soils. Those, for instance, met with on a chalk down are almost entirely different from those on a gravelly heath or in a marshy meadow. Again, the presence of certain animals depends upon the existence of localities suitable for their habitation, or of the plants necessary to them as food. The subject is one for which I can claim no sort of originality, but I hope that an amplification of the text which I have chosen may not be without interest as illustrating the links which connect the different branches of natural history studies. My remarks refer especially to south-eastern England.

In classifying soils for our purpose, we have to regard them from several points of view. We have to consider the top soil or surface mould in which terrestrial plants take root; also the subsoil, from the disintegration of which the surface soil is mainly formed, and upon the nature of which the character of the latter greatly depends. We may classify the subsoil according to its geological age, distinguishing the deeper strata upon which the general contour of the country mainly depends, and the more superficial strata or "drift" by which the character of the surface soil is often modified.

As regards their physical characters, rocks and soils may be grouped according to their hardness or softness; perviousness or imperviousness to water; dryness or moisture; and into light or friable and heavy or retentive soils.

As regards their chemical composition, subsoils may be classified as: (*a*) hard crystalline rocks, as granite and slate—these are not represented in the south-east of England; (*b*) calcareous, as chalk, the harder limestones (of which also we have no representative in the south-east of England) and marl; (*c*) silicious, as sand, sandstone and gravel; (*d*) argillaceous, clay and shale; (*e*) peat; (*f*) soils of mixed character, as alluvial loam and boulder clay.

From an economic point of view, there is also the division into fertile and poor soils. The qualities which render a soil valuable for agricultural purposes are the depth of surface soil, its richness in nitrogenous organic matter and in readily soluble mineral constituents, and its aeration and nitrifying properties—the latter being due to

* Being a paper read before the Annual Congress of the South-Eastern Union of Scientific Societies at Croydon, June 3rd, 1898.

the presence of certain micro-organisms. For the field-naturalist, however, a fertile and highly cultivated tract is apt to present less of interest than a wilder or more barren region in which nature is seen under a more primitive aspect.

The deeper structure of the ground, the "solid geology," as it is called, is the factor which has had the chief influence in moulding the contour of the surface. The harder strata, which present the greater resistance to denudation, have, in the course of ages, been left standing out in relief as hills and headlands, while the softer beds have been worn out into valleys and bays. In the south-east of England, as already mentioned, we have no old crystalline or igneous rocks, and no hard limestones, nor have we mountains on which to find an Alpine flora or fauna. The chalk is the dominant feature of our area. It exists, or has existed, over the whole region, either on the surface or covered by newer beds. Being of great thickness, with comparative hardness and resistance to denudation, it forms a series of hill ranges, on which plants and animals of kinds which prefer a calcareous soil abound. The other hill ranges in our area are formed by the silicious beds of the Lower Greensand, Hastings sand, or tertiary gravels. It is on these latter ranges that the few plants of northern or mountain type which occur in our area are met with, *e.g.*, the club-moss (*Lycopodium clavatum*), at Leith Hill, Holtye Common and Tilgate Forest.

The rainfall increases, *caeteris paribus*, with the elevation, and the moist air of these wooded hills is favourable to the growth of cryptogams, such as ferns, mosses, lichens and fungi. These are far more plentiful in those situations than in lower and drier regions, and more especially than in such as are exposed to the deleterious influence of town smoke. The existence of hard strata is also necessary for the formation of steep, rocky sites, suitable for the habitat of rock-loving plants. Hence, except on the sea coast, where we have fine chalk cliffs—at Dover, Beachy Head, and in the Isle of Wight—we have few outcropping rocks in south-eastern England; the chief examples of inland rocks being those formed by the massive beds of the Tunbridge Wells sandstone, such as those near Tunbridge Wells and West Hoathly. These sandstone rocks are the habitat of the filmy fern (*Hymenophyllum tunbridgense*), now, I fear, extinct at the locality from which it takes its name, but still existing at a few secluded spots in the Weald.

The harder strata are all commonly permeable to water, and thus, if above the line of saturation, form thin dry soils, suitable for growth of certain plants often of a dwarf habit. In tracts formed wholly of permeable strata, as the chalk plateau of Surrey, aquatic plants and animals are necessarily rare and few in species, being met with only in isolated artificial ponds, where they have been introduced by some casual agency. It is not infrequent to find isolated ponds tenanted by a single species of water-snail, while in waters connected with an extensive waterway, a variety of species are commonly present.

Moist places occur where water lodges in hollows on impervious soils and where springs break out at the junction of pervious and impermeable beds. The greatest variety of aquatic and marsh plants is commonly found in low-lying tracts near the lower reaches of large rivers, the dissemination of such plants being assisted by floods.

Impermeable strata, especially clay, form a heavy soil which supports a strong coarse vegetation, consisting largely of perennials and trees, or shrubs; while on the other hand, dry, hard and permeable beds are covered commonly by a thin soil and a short velvety turf.

The difference in the flora growing on subsoils of different chemical composition is connected, no doubt, partly with differences in their physical characters, but also partly depends upon differences in their chemical constituents, *e.g.*, the presence or absence of lime. Calcareous strata, of which in the south-east of England the chalk is our main example, are typically dry, hard and permeable. Where superficial, as on the slopes of the chalk downs—the plateaux being often capped with gravelly or clayey drift—a calcareous rock is covered with a thin loamy surface soil and a dense green velvety turf. The flora of a calcareous tract is notable for its great variety, the number of species met with on such a tract being much larger than that on one of sand, clay or peat. It also comprises many typical species rarely or never met with on other than calcareous soils. Among such species may be mentioned rockrose, hairy violet, wild mignonette, lesser burnet (*Poterium*), dropwort (*Spiraea filipendula*), wild parsnip and carrot, marjoram, juniper, yew, and bee orchis, while the list might be greatly extended. There is some difference between the flora of the harder and drier beds, such as the Upper Chalk, and the heavier marls, such as the Lower Chalk. Some species, such as *Spiraea filipendula* and *Hippocrepis comosa*, preferring the former, while others, such as *Chlora perfoliata*, and various species of orchids, prefer the latter. On the other hand, a calcareous soil is equally characterised by the absence of plants, common and abundant on other soils, such as foxglove, heaths, bilberry, and some of the larger ferns.

Chalk downs and hills on a calcareous soil are the special habitats of many species of insects, such as burnet moths (*Zygaena filipendulae*), marbled-white butterflies, and several of the blue butterflies (*Lycaena*). A calcareous soil, too, is specially favourable to the abundance of land molluscs, doubtless on account of the plentiful supply of

lime which they find to serve in the material for their shells. The large Roman snail (*Helix pomatia*), is only found in Britain on chalk and limestone hills, as is also the case with *Cyclostoma elegans*, a species with an elegant spiral shell, the mouth of which is closed with an operculum, or trap door. It is the only British representative species of a large tropical genus. The trunks of beech trees on a chalky soil are the favourite resort of various small snails of the genera *Bulimus*, *Clausilia*, etc.; while dry stony places are frequented by minute kinds, such as *Pupa* and the small species of *Helix*.

The rain which falls on a chalky or limestone soil in great part sinks into the ground and reissues at the lowest point at which it can find an exit in copious springs of clear water, forming streams which maintain their volume and temperature comparatively constant throughout the year. Hence in cold weather these streams are warmer than the air, and the water-weeds, such as various forms of *Potamogeton*, *Ranunculus*, *Ceratophyllum*, etc., with which they are often full, maintain their growth through the winter. The clear chalk streams are also frequented by trout and other freshwater fish, such as miller's thumb, loach, bleak and grayling. The freshwater crawfish is also only found in hard-water streams, but prefers those which are somewhat muddy. Freshwater molluscs are also plentiful in such streams, for the same reason that the land species are on a chalky soil.

(*To be continued.*)

ORIGIN OF SPECIES IN INSECTS.[1]

By J. W. Tutt, F.E.S.

Doubtful Species.

YEAR by year we are faced, in some form or other, with the question: "What is a species?" Year by year this question is discussed in our magazines without getting any nearer to a definite issue; year by year the discussion will go on so long as there are those who think that every species can be defined with unerring accuracy, so long as there are those who think that every species is distinctly cut off from its nearest allies, that there are no species in the process of making, as it were. We have for several years discussed the specific identity, and the reverse, of *Tephrosia crepuscularia* and *Tephrosia bistortata*, and have arrived at no very satisfactory results. Everyone seems willing to grant that they are what may be called "doubtful" species, that is, that the characters by which they may be differentiated from each other are not sufficiently decided to leave no doubt, in some cases, as to which species a particular individual specimen should be referred. In other words, it is stated, that even specialists cannot invariably determine them.

Hybridity of Allied Species.

The practical work which Mr. A. Bacot and Dr. W. S. Riding, F.E.S., have successfully carried out in the direction of hybridising these species, appears to me to be of the greatest importance, and the results arrived at may possibly be very far-reaching in their character. That these species are very closely allied, everyone allows; that the distinctive characters are so ill-defined as to make it a matter of difficulty, except for the trained specialist, to discriminate, may also be conceded. They are species in the making, as I have just said, and their specialisation is not yet completed. It is clear that, if the theory of evolution by natural selection be sound, there must be many cases, and there must be, in nature, every gradation between the polymorphic and unstable species in which almost every individual varies from almost every other in some slight and unimportant manner, through every gradation of varieties (local races) and sub-species to clearly-defined species.

Each species is separable from its nearest allies by certain characters which will differentiate it from all other species. These we call specific characters. Some naturalists, and I disagree entirely with them, go so far as to include all species that will pair and produce offspring as being one species. Under these conditions we should have to unite *Smerinthus populi* with *S. ocellatus*, *Amphidasys strataria* with *A. betularia*, *Saturnia carpini* with *S. pyri*, and a large number of species well-defined on many characters in all their stages of existence. We should also have to unite the pheasants, *Phasianus colchicus* with *P. torquatus;* the hare, *Lepus europaeus* (*timidus*), with the rabbit, *L. cuniculus;* and endless other birds and mammals which are abundantly distinct. When the question of hybridity was first studied it was laid down as an axiom that all hybrids were sterile, and when it was found that fertilization between two plants or animals was possible and that fertile progeny resulted, the plants and animals were reduced at once to the rank of varieties. As, however, our data on this subject accumulates, it appears to be certain that a very large number of closely allied, but, in the generally accepted sense of the term, perfectly distinct, species are

[1] Being part of a Presidential Address delivered before the members of the City of London Entomological and Natural History Society.

not only reciprocally fertile, but their hybrids are also fertile *inter se*. Before, however, we can assert that we really know anything about the subject, a very great number of careful experiments on many different species must be carried out and the results compared.

Variations always present.

The general tendency not only for all organisms to vary, but also for every constituent structure and part of an organism to vary, is so well-known, that, in re-reading any of Darwin's works, one is struck by the frequency with which he prefaces his remarks with "if the species vary," or some similar phrase. One has some difficulty in conceiving how vastly our facts relating to variation have increased during the last half-century. As entomologists we know very well that in every individual brood of any given species there is an abundance of variations present, upon which natural selection might work in many directions. If this be once thoroughly understood, and, if to this be added the fact that an inconceivable percentage of the progeny of every living insect (even if only judged by the standard of lack of increase in numbers of common species of Lepidoptera in well-known localities) is annually destroyed by various causes, nature continually weeding out the less fit, so that only a few selected and well-favoured individuals reach maturity, then one can readily conceive that natural selection may have much to do with the process of the formation of a new race under the most favourable conditions. There can be little doubt that, by a slow process of the selection of suitable variations presented by a species, nursed under the most favourable conditions, on lines similar to those already indicated, species have been formed.

Utility and the Origin of Specific Characters.

It may not be out of place now to say a few words on the evolution of those "specific characters" which every species possesses, and which ultimately result in the differentiation of each individual species from all others. I have attempted to show in certain articles that I published on "Mimicry" (Entom. Record, vol. viii.) that utility is the mainspring on which the formation of mimetic patterns depends, and that utility has guided natural selection to act in ways advantageous to the species in their evolution. I would also urge that utility is again the guide by which natural selection is driven into the paths advantageous to the species when it brings about the development of new forms, which ultimately become new species. On this question Huxley says: "Every variety which is selected into a species is favoured and preserved in consequence of being, in some one or more respects, better adapted to its surroundings than its rivals. . . . . For, as has been pointed out, it is a necessary consequence of the theory of selection that every species must have some one or more structural or functional peculiarities, in virtue of the advantage conferred by which it has fought through the crowd of its competitors and achieved a certain duration. In this sense, it is true that every species has been originated by selection." Dr. Alfred Russel Wallace says: "Perhaps no principle has ever been announced so fertile in results as that which Mr. Darwin so earnestly impresses upon us, and which is, indeed, a necessary deduction from the theory of natural selection, viz., that none of the definite facts of organic nature, no special organ, no characteristic form or marking, no peculiarities of instinct or of habit, no relations between species or between groups of species can exist but which must now be, or once have been, useful to the individuals or races which possess them." Here it is quite evident that two of the greatest thinkers on this subject accept the principle of the utility of specific characters, at any rate, at the time of their origin as such; and, although it is possible that certain specific characters may exist in certain species which are now of no direct advantage to their possessor, yet there can be but little doubt that at some previous time in the past history of the species they were either themselves useful, or were correlated with some useful character.

Average Characters.

As I have already pointed out, the amount of variation that occurs in each species year by year is much greater than was originally supposed. Yet the weeding out of the most marked aberrations results in the production of what may be called a general facies, presenting an average of the special characters for each particular species. In spite, therefore, of the variation that exists between the individuals of a species, a similarity is preserved which enables the species to maintain itself in its given environment.

Individuals of Species not Identical.

When the materials acted upon are identical, and the conditions under which they are acted upon are identical, we may take it as a general axiom that the same cause will produce similar results. In the true sense of the word, the individuals of no species are identical, and hence the same cause acting upon the individuals under the same conditions does not produce the same results, except in a very general manner. Bearing this in mind, we may proceed to the consideration of a

few special phenomena that have proved interesting to me.

Origin of Varieties or Local Races.

We may make the general statement, subject to the above limitation, that uniformity in environment tends to produce a general uniformity in the species; whilst great differences of environment tend to produce great differences in the species. Many species of Lepidoptera bearing out this general statement, will occur to all entomologists, yet it is not difficult to mention species whose appearance suggests antagonism to the general principle here enunciated.

The well-known *Pyrameis cardui* has an almost cosmopolitan range. It exists under a variety of physical and climatic conditions in both the Old and New World, yet it is a species that varies little. As a matter of fact, in spite of the apparent dissimilarity of its habitats, these are comparatively alike. The species inhabits the sub-tropical and warmer temperate regions of the world. Hence the climatic conditions are not unlike. From these areas it is a wanderer, and has no lasting habitation in the colder regions, of which it is reported to be a native. Its habits are similar all over the world. By the swiftness of its flight it escapes from its enemies, and, on a flower-head, at rest, it is sufficiently protected to be difficult of detection. Variation in its colours would be of no service to the species; hence, in spite of its wide range, there is no attempt to set up local colour variation. The Australian form, *kershawi*, shows a tendency to develop a transverse row of ocellated spots on the hind-wings. Now and again a striking aberration may be bred or captured, but these do not amount, perhaps, to one in a million, and do not affect the general question. Here, then, we have an instance of a species in which variation in hue would be of little or no use to it, and we find as a result that its colour and markings are very rarely modified, whatever may be the conditions of its environment.

Let us now consider for a moment, a species that depends not upon its swiftness of flight, but upon its colour and markings, for its safety. No better example can be selected than *Amphidasys betularia*. Its pale grey-white colour, plentifully peppered with black dots, forms about as useful a pattern as one can well imagine for the protection of this species. On the tree-trunks on which it rests, its colour and markings are its salvation. Yet its colour would be fatal on the black fences and tree-trunks to be found in all manufacturing districts. In these districts, natural selection has eliminated the pale conspicuous forms, and a melanic form known as the var. *doubledayaria* has been evolved in its place. The process of evolution has been exceedingly simple, just the weeding out of the most conspicuously pale specimens, and the retention of the darker and less conspicuous forms. The same process of selection has taken place in the formation of the melanic aberrations of *Tephrosia crepuscularia*, *T. bistortata*, *Diurnaea fagella*, and numbers of other species. Utility is the mainspring of the formation of all these melanic forms. The physiological factors of variation necessary for the production of this result were, and are, present in all these species. They possess, in their typical forms, black and white scales in varying numbers; utility has seized on the useful character, and has moulded the material at its disposal into its own channels for the advantage of the species.

Again, let us examine a species like *Gnophos obscurata*. This species, as all lepidopterists are aware, rests upon the ground, and is entirely dependent for its protection on the resemblance which its colour bears to that of the rocks upon which it rests; and this resemblance is perfect—black on peat and dark slate, grey on limestone, white on chalk, with such a nice gradation in tint, corresponding with that of the different rocks upon which the species is found, that one can almost tell exactly where individual specimens have been captured. Here, the part that utility has played in the determination of the various local races of this species is obvious.

I do not here wish to enter into the physiological processes involved in the development of these local forms. I only want to point out that they have been developed, because the points which distinguish them from each other and the type, are severally useful to the species, under those conditions of environment by which each individual form finds itself surrounded. The modification of many of the species here incidentally referred to—*Amphidasys betularia*, etc.—in the direction of melanism is largely connected with certain habits that these species possess in common. The phenomenon, too, is undoubtedly of comparatively recent occurrence, and has largely increased within the last fifty years. That the phenomenon, as exhibited by these species, has been brought about by changes in the environment, must be obvious to all who will only look for them. The modification of other species—*Gnophos obscurata*, *Dasydia obfuscata*, *Agrotis lucernea*, etc.—with a slightly different habit, sometimes, in a somewhat similar direction, is of much greater age, and dates back, probably, as long as the species have rested on differently coloured rocks in different localities. Still, the hand of utility is just as evident here, as in the previous cases. What is true of the formation of these local races, must be true in a measure of species themselves.

(*To be continued.*)

NATURAL GAS IN SUSSEX.

By Charles Dawson, F.G.S., F.S.A.

IN introducing my subject (1) I do not think it necessary to make any elaborate references to instances of discoveries of natural gas in England and abroad. Suffice it to say that manifestations of natural inflammable gases have occurred in almost every country and geological formation throughout the world, and have frequently been put to practical use.

I will, however, mention what seems to have been one instance of its appearance in London, quaintly recorded by one Mathew Paris, about the year 1256. Under the head of "A Sudden Subterranean Explosion," the chronicler says: "About this time, as some workmen were digging out the bed of an aqueduct in London, to clear the bed of mud (for the water had ceased to flow) a sudden explosion burst forth from the ground, accompanied by a flame similar to the fire of Hell, which, in the twinkling of an eye, suffocated several of the workmen, killing one of them on the spot, and so burning, maiming and disfiguring others that they were entirely useless to themselves ever afterwards. There were some who said that this explosion occurred as by a miracle, because those men were engaged in servile work at an improper hour in the evening." It quite sounds as if the Factory Acts had been anticipated in those days!

This interesting record has a somewhat similar parallel in the County of Sussex, and I may quote it for the benefit of well-sinkers personally and master well-sinkers generally who may come within the provisions of the Employers' Liability Acts. I am indebted for the account to Mr. Henry Nicholls, of Deal, an owner of property at Hawkhurst in Sussex. He states that between the years 1836 and 1840, at Hawkhurst, a well was there sunk to a depth of 98 feet. After passing through a certain amount of heavy sand, a blue clay of very oily flaky nature was met with, mixed with yellow and red streaky clay. This continued to the bottom of the ninety-eight feet. An artesian boring was then commenced, the workmen working by candle light. Having bored some fifty feet more, or 148 feet from the surface, the augur struck a rock and fell into a cavity. An inflammable gas immediately ascended, which got ignited by the lights the workmen were using. Two men were immediately killed, and as an eye-witness says, the gas burned slowly up the well till it came near the top, when, coming in contact with the outer air, it burst out into a sheet of flame some twenty feet high. It then slowly burned itself out. The water in the well was useless, and Mr. Nicholls had the well filled up. This seems to have been an instance of an inflammable gas occurring in association with strata containing a rock oil—the gas itself accumulating in a cavity, or what is called by the Americans, a "pocket." It serves to show that it is unwise for well-sinkers to use artificial lights at the bottom of a well when boring for water—except, perhaps, in properly constructed mining lamps.

Another somewhat interesting occurrence took place near Ticehurst Road, Sussex, about six or seven years ago. There is a certain low-lying field close to the Ticehurst Road (S.E.R.) station, called the "Bogs Brook." It is a marshy spot, and sometimes large bubbles of inflammable gas continuously rise and break on the surface of the pools. One Sunday in a particularly dry summer, when the bog was dried up, some boys were about to enjoy a clandestine smoke of tobacco, when a match thrown down suddenly ignited something believed to be inflammable gas. The boys ran away, and the whole field was soon a mass of flame; the peat of the bog also took fire. I am told the spot, which is in view of the railway, was visited by thousands of people at the time, and it burned for a week or more, when some heavy rains soaked the land and put out the fire.

These subjects, although interesting, have perhaps only a relative interest to the more important one of the occurrence of inflammable gas coming from artesian borings, having a continuous flow during months and years, and existing under a high degree of pressure. The occurrence of inflammable gas is mentioned by Mr. Henry Willett, F.G.S., in the famous Sub-Wealden boring at Netherfield, 1875, occurring in the Purbeck strata and at a short distance above certain strata in the upper "Kimmeridge clays," recorded to be very rich in petroleum. This seems to be the first record we have of a class of gas which has now again been met with in East Sussex. Of course I do not now speak of gases emanating from petroleum at high temperatures, but of certain gases usually found in a free state in association with petroleum, and perhaps, therefore, owing their origin to some common causes and conditions.

An inflammable gas was met with in a boring, made by Messrs. Le Grand and Sutcliffe, the celebrated hydraulic engineers, at the Heathfield Hotel, in rocks the horizon of which is very little higher from that discovered by Mr. Willett. The

(1) Read at the Conference of the South-Eastern Union of Scientific Societies, Town Hall, Croydon, June 3rd, 1898.

foreman of the works made some experiments in piping off the gas. No water was discovered, so the boring was closed up, and no more was thought of it until the same firm of engineers, by order of the London, Brighton and South Coast Railway Company, again made another boring to the south about one hundred yards distant, commencing in the railway cutting about forty-three feet in depth below the level of the top of the former boring. In this boring, but at a greater relative depth, gas was first noticed. I say first *noticed*, because it is now certain that gas first began to come into the boring at a higher level; perhaps at the same relative level as in the former boring. The rush of gas became greater as the depth increased, and when tested at the top of the bore-tube with a light, by Mr. E. Head, the station master at Heathfield, a column of flame sprang up to the height of about sixteen feet, and was with great difficulty extinguished. A certain amount of water was discovered, but not sufficient for the Railway Company's purpose, and the boring was abandoned; nearly all the lining tubes being withdrawn. Notwithstanding the partial blocks thus occurring through the falling in of the sides of the boring and the pressure of a great column of accumulated water in the bore hole, the gas still continues to flow from the bore-tube in a considerable quantity. It has been calculated that the pressure of the gas at its source at the bottom of the tube cannot be less than 135 lbs. to the square inch.

It is perhaps somewhat providential that some obstruction has happened to prevent the enormous loss of gas that would have occurred if the tube had been left entirely open during a period of now nearly two years. The Railway Company have screwed a cap on to the end of the tube with a small half-inch outlet from which the gas has been allowed to flow continuously.

With the kind permission of the Railway Company, whose officials are giving every assistance and facility, my friend Mr. Lewis, C.E., F.S.A., and myself have conducted various interesting experiments with the gas; and permission has been obtained from the Company for a demonstration of the gas, when used in various burners, on the occasion of the visit to Heathfield of our affiliated society, the Brighton and Sussex Natural History and Philosophical Society.

Respecting the origin of the gas, we look in vain to the rock details of the boring for information. It is true that certain small beds of lignite occurred in the section, but one cannot account for the enormous supply and pressure of gas on any theory that the gas emanates from these beds. A portion of the lignite in one of the beds occurred at the depth of 347 feet at the junction between the "Fairlight Clays" and the "Purbeck Beds," consisting of blue sandy marl rock with bands of lignite, and has been analyzed by Dr. J. T. Hewitt, Professor of Chemistry at the Technical College, East London, on behalf of the Railway Company. He reported to the Company that the lignite contained: moisture, 4·90; volatile matter, 15·55; fixed carbon, 1·74; ash, 77·81 = 100·00. This record, I take it, is about the usual result of the analysis of lignite, and, I fear, throws very little light on the subject.

The greater probability seems to be that the gas is derived from either the "Purbeck Beds" or the "Kimmeridge Clays," by percolation through the comparatively porous strata above. The "Purbeck Beds" are known to contain a certain amount of petroleum and bituminous matter, one bed being particularly rich; but far richer beds lie below in the "Kimmeridge Clays," immediately above which Mr. H. Willett discovered the gas.

This is a matter, however, as also the subsidiary one of the association of petroleum, which can only satisfactorily be determined by means of a deeper boring. Possibly the large supply of gas at Waldron indicates the presence of a larger quantity of its usual associate (petroleum) than has been before recorded in the underlying beds.

Dr. Hewitt has also reported to the Railway Company on the constituents of the gas. He states that the gas is composed of three constituents: Marsh gas, 91·90; hydrogen, 7·20; nitrogen, ·90 = 100. The two first of the above gases, it may be remarked, are inflammable, but burn only with a blue, non-luminous or comparatively non-luminous flame. Nitrogen is not an inflammable gas. It is clear, therefore, that there is nothing in the analysis which can account for the illuminating power of the natural gas at Heathfield, which burns with a brilliant yellow flame. The gas, when burnt in an ordinary "batswing" or "flat-flame" burner, is so luminous that any ordinary and casual observer would not remark the difference between it and ordinary household gas, although the difference does actually exist (1). We must consequently, therefore, suppose that either some luminous property in the gas did not present itself in the sample taken away by Dr. Hewitt, or else some variation has occurred in the constituents of the gas, a feature which appears to be not uncommon in the natural gas of the United States, but in truth I believe not quite to the same extent. I myself and others have seen the gas burning at many times and at different periods, but this non-luminous phase has not presented itself to me or to anyone with whom I have yet met.

I will, therefore, confine my remarks to the gas

(1) The ordinary illuminating power of the raw flame is 9½ candles per cubic foot. In an incandescent burner of the Denarouze Company it equals 29·6 candles per cubic foot, or fifteen to twenty per cent. better than London gas.—C.D.

which, out of respect for Dr. Hewitt, I will call its normal or luminous phase. Under these conditions the gas has been carefully analysed by Mr. S. A. Woodhead, B.Sc. (Public Analyst for Sussex and Professor of Chemistry at the Agricultural College, Uckfield), and I here beg to record my grateful thanks to Mr. Woodhead, who has occupied much time and taken much trouble to secure the accuracy of his determinations. He constructed his laboratory on the spot at Heathfield, an unlimited amount of gas being supplied to him direct from the bore-hole by means of tubes, and he has taken care to check his results. The analysis, speaking roughly, agrees fairly well with that of Dr. Hewitt respecting the presence of Methane (or Marsh gas), but Mr. Woodhead's analysis reveals the presence of certain hydrocarbons which, from an illuminating point of view, may make all the difference in accounting for the undoubted illuminating power of the gas. There are other important differences between the analyses, which are outside of the scope of the present paper.

I may remark in general that the natural gas, in common with the American natural gas, so frequently discovered above and in association with the petroleum springs, is chiefly remarkable for its great heating power when mixed with a large proportion of air. Its main usefulness may thus be said to consist in lighting by incandescent burners, for fuel in manufacturing-engines, and general household purposes.

Whatever results may accrue from these lighting and heating properties, or whatever the discovery may point to in a commercial direction, the fact nevertheless remains that the discovery is a subject both interesting and instructive, and, I think, worthy of consideration.

Uckfield, Sussex.

THE ACETYLENE EXHIBITION.

CONSIDERING that it is only about four years since M. Moissan first discovered the present process of making carbide of calcium in an electric furnace, we may describe the exhibition now being held at the Imperial Institute, South Kensington, as a success. Carbide of calcium is the basis of acetylene gas. It has been interesting to watch the progress of invention in connection with the acetylene gas industry. Mechanics have in many instances set science at defiance, and consequently in such cases the failure has been great. Still, the exhibition of apparatus for making the gas and lamps for burning it makes a brave show when it is fully alight at South Kensington, as such failures have been weeded out.

It would be difficult to find any place so perfectly illuminated as the gallery at the Institute, which is lit by acetylene. It produces a brilliant but not harsh effect, and colours fugitive by other artificial lights appear as in daylight; so the pictures adorning the rooms specially prepared to exhibit them by acetylene light show to the best advantage. The light will be invaluable for town and country naturalists on account of this quality. The exhibition, although promoted by a company of carbide makers, is to a large extent under the auspices of the Society of Arts and the Executive of the Imperial Institute. A committee formed for preliminarily examining the apparatus before being accepted was appointed by the Society of Arts, which decided on certain rules that appear good as a whole, when we are reminded of their lack of precedent. This committee included Major-General Sir Owen Tudor Burne, K.C.S.I., Sir Frederick Bramwell, Bart., D.C.L., F.R.S., Prof. James Dewar, LL.D., F.R.S., Mr. Harry Jones, M. Inst. C.E., Prof. Vivian Lewes, F.I.C., Mr. Boverton Redwood, F.R.S.E., Prof. W. C. Roberts-Austin, C.B., F.R.S., Prof. J. M. Thompson, F.R.S., and Sir Henry Trueman Wood, the Secretary of the Society of Arts. It is said that a rigid examination was made, under the direction of those gentlemen, of all apparatus sent in for exhibition, and several proposed exhibits were rejected. It is not easy to say how many exhibits are at present on view, as we understand the catalogue has not been issued. There are, however, about a couple of dozen generators of different types, making the gas for as many chandeliers. In the north gallery are also numerous stands of exhibits showing the various forms of generators and lamps.

With regard to the generators, there are three systems at work: (1) those in which the gas is generated by water being allowed to drip, or flow in a small stream, on to the top of the carbide; (2) those in which water rises around the carbide; (3) those in which the carbide falls into the water. An examination of the exhibits shows that the former system has been hitherto chiefly adopted by the inventors. This system is certainly the most easily manipulated in designing either a generator or a lamp, and has naturally, therefore, been followed. We have it, however, on the authority of Professor Vivian B. Lewes, who has studied the question, that the safer method is the plunging of carbide direct into the water. We purposely, at this stage, refrain from especially noticing any particular exhibit, as all are being tested under the direction of the committee above referred to. In due course a report is to be issued with reference to the exhibits. Acetylene illumination is "in its infancy," as we used to say of electricity, and will doubtless be perfected very rapidly, as it is already an irresistible competitor to both electric and coal-gas lights. The exhibition is well worth visiting, especially as being the first of its character in Britain.

LUNDY.[1]

By Alfred J. H. Crespi, M.D.

SOME audacity is needed to write a paper on the tiny island looming up in the interminable waste of waters west of Ilfracombe and Barnstaple, sometimes only a faint blue streak on the horizon, at others magnified by the mist, imposing, and of vast but uncertain size. If half the charm of a place consists in novelty, and half in unpolluted fresh air, Lundy can claim a high position. As for novelty, I dare assert that not the loneliest seaside village nor the newest of new watering-places can compare with it. Alone it stands in its glory, little affected by the flight of centuries, innocent of trees, far beyond the sound of railways, and a few years ago, before the cable was laid, rejoicing in infrequent posts, and in as precarious communication with the rest of the kingdom as any place could have been and still remain part of the British Isles.

Its configuration is imposing. Its long diameter points nearly due north and south, while its eastern slopes, precipitous enough to make them interesting and romantic, are only one degree less striking than its western sides, where walls of rock rise in perpendicular steps, sixty and eighty feet at a time. The western side is particularly imposing; and were Lundy more accessible, or had it a land-locked harbour, it would have thousands of visitors. But it has no harbour, no landing-pier or stage, and though the beach at its south-eastern extremity is good, it is not always accessible nor perfectly safe. Not seldom, especially in brilliant spring easterly weather, furious seas roll upon that beach, as though they would sweep the very island away. Lundy is then completely cut off from all communication with the mainland, except by the telegraph. A few years ago a cable was laid down between Hartland, on the Devon coast, and the South Point; but, unless I am misinformed, the telegraph is not always in working order. Off Lundy the anchorage is excellent in westerly gales, and then, especially if the storm lasts some days, numbers of ocean-going steamers and fine sailing-ships, with whole fleets of skiffs and tugs, take shelter under the lee of the island and stay till, with a shift of the wind to the east, they are off to some less exposed roadstead.

Altogether I have lived on Lundy three years and a-half, and after much hurrying to and fro and long residence in great cities, the contrast was complete. Quiet and leisure I had in abundance, for my professional duties were a sinecure; but, cut off from conflict and competition, the inclination to work and to make profitable use of my time was wanting, and never did I do less, never did I get through fewer books. In Lundy I used to lie awake listening to the piercing shriek of the restless wind, as the damp rapidly moving air did not fully agree with me, and accounts for nearly all the ill-health on the island. Something too might be due to the difficulty of taking sufficient active out-door exercise. No, whatever poets may say to the contrary, the man exposed to the storms and distractions of life works hardest and does best. Lord Lytton works this out beautifully in that gem of fiction, "My Novel." Rural retirement is more captivating to the imagination than in the reality. The more one has to do the stronger the inclination one commonly has to undertake fresh work. The thinker, or he who aspires to be reckoned such, must live among men and be sharpened by intercourse with his fellows. Even the poet must not fly to the desert for inspiration; and Lytton, in accounting for Leonard Egerton's failure to produce a second masterpiece, gives as an explanation his fatal mistake in burying himself in a remote western village. I am not sure that Natural History would gain at the hands of a recluse, whose theories were not corrected and observations tested by critical and sceptical colleagues.

Lundy is in many ways noteworthy. Its chief attractions are its bold rocks, climate, bird-life and vegetation, to say nothing of its history, the last not eventful, but going far enough back to invest it with some interest. On the south point, overlooking a narrow and dangerous neck of land, connecting the main portion of Lundy with Lametry, stands a small castle—rugged, ancient and gloomy—once the stronghold of a Norman baron, and still called "The Castle." Its original lord and founder was a certain De Marisco, a name said to be a corruption of De Montmorency. The island, according to tradition, was granted many centuries ago to the Knights Templars, who, however, never took possession of it. Then it passed from one noble to another, was the scene of much petty fighting between Welsh and Irish, and finally, sixty or more years ago, came into the possession, by purchase, of the late William Hudson Heaven, a quiet, amiable country gentleman, who made it his home for many years, and there died. The present owner is his son, the Rev. Hudson Grosett Heaven, M.A., of Trinity College, Oxford, an able and accomplished man, of scholarly tastes, who has the rare felicity, in the south of England, of being absolute lord of all he surveys, without equal or rival for many miles.

The top of the island is an extensive and toler-

[1] Being an Address given April 15th, 1898, before the Haslemere Natural History Society.

ably level table-land, sloping slightly towards the north and east, with no trees, no hedges, and no shelter. This absence of shelter is a serious drawback, and diminishes the value of the land for agricultural purposes. From the comparative mildness of the winter and the absence of severe frost, were there only good shelter, large quantities of excellent early vegetables might be grown for the Bristol markets. Perhaps, were sufficient expense incurred, some shelter might be made on the eastern slopes, and vegetables of fine quality could be grown a month earlier than on shore. After the end of March white frost is rare. In March, 1878, the lowest reading was 32° F., in April, 33°, and in May, 39·5°. In March, April and May, 1879, the readings were respectively 29·5°, 30·5° and 36·5° F., and in 1880, in the same months, the minima were 36°, 39° and 38·5° F. The mean temperature of the island must be about 50·5° F., its chief peculiarity being the mildness of the nights, especially in spells of severe weather on shore. But the moderate summer maxima reduce the annual mean far below the figures which the mild winter would lead one to expect. Unfortunately, the elevation of the island and the want of shelter from the wind more than counterbalance the exceptional advantages which the absence of low temperatures would offer.

The south half of Lundy has long been cultivated. There the grass is fine and green, and the crops are of superior quality. The northern half is still in a state of nature, with shallow soil or bare rock, and more lichen and moss than turf. The slopes of the island, locally called "sidelands," are in places exceedingly beautiful and attractive; in others—chiefly, though not wholly, on the west—majestic; and they impress the few people who have the good fortune to see them as far surpassing in rugged, untamed grandeur, anything else in the south of England, not excepting the precipitous rocks near Land's End and those near Swanage, which cannot be much more than half as lofty. On the slopes, well under the shelter of the mass of the island, but some distance above the water, the soil is in places deep; it is contained in pockets, where it has accumulated, and there many species of wild flowers luxuriate, and attain a splendid size.

The crowning charm of Lundy is the opportunity it offers for studying natural history, for its speciality is its wild birds, which once abounded. In former days when they rose they filled the air with discordant cries, but long before I took up my residence on the island their numbers had greatly diminished, and though protected as much as possible by the present squire and his sister, serious inroads have been made upon their numbers, and they no longer rise in the dense clouds reported by earlier visitors. In April they "come in," and in a few weeks almost cover the rocks and the more inaccessible headlands. A little later they commence to lay their eggs. The species commonly met with are several sorts of gulls, guillemots, shags, razor-billed auks, puffins, and a few, alas! only a few, gannets, that noblest of British sea-birds, which darts like a ray of light from off the rocks far below the watcher's feet, and not much above the water. It is said Lundy is the lowest latitude in which the Solan goose nests, though that distinguished Oriental scholar and traveller, the late

LUNDY: HARBOUR AND RAT ISLAND

Dr. W. F. Ainsworth, had seen it flying along in its majestic fashion off the coast of Portugal. The gannets choose open ledges, and most of them, almost of necessity, lay where daring climbers can get their eggs. The temptation is irresistible; and as the work of destruction never ceases the wonder is that any escape, what with the depredations of other sea-birds—who can be seen sitting in most contemplative and philosophical mood with half an egg-shell impaled on their beaks,—what with the rats, and what with the assiduous attentions of islanders, sailors and pilots. I do not want to accuse sea-birds of being cannibals, and eating their own eggs; that would be too cruel a charge. But do they not eat the eggs of their unfortunate friends? At any rate they are often seen sitting reflectively with the remains of an egg on their beaks, and sharp human eyes have before now seen a guillemot with a guillemot's egg thus impaled. Truly the eggs in the season have many enemies. Puffins generally lay their eggs, much resembling those of the domestic fowl in size and shape, though not quite of the same colour, in burrows, and consequently many escape. Razor-bills also choose obscure and unsavoury nooks behind large masses of fallen rock, but gulls and guillemots are less astute and far-seeing, and deposit their eggs in full view of the egg-gatherer. Solan geese select by preference bare ledges, not particularly difficult to reach, and few of their eggs are hatched out. The largest egg is the gannet's, and usually fetches sixpence for the egg-gatherer; but the most brilliantly coloured is the guillemot's, which is green, white or blue. Birds generally lay eggs that vary a little in colour, but guillemots allow themselves great latitude. Nests are not made, except very rude ones by gannets and gulls, and a little rubbish is scraped together by some of the puffins; sea-birds do not excel as nest-builders.

The tameness of the birds at the breeding season takes the landsman by surprise, and some of the smaller species actually remain on their eggs until driven off. They naturally resent the attempt to remove them, and opening their formidable beaks, snap with right good earnest at the fingers of the egg-thief. Of all quaint little creatures, none surpasses the puffin, with its comical physiognomy and red colouring, so much more vivid in life and in its native haunts than in museums, where, however skilfully the bird-preserver does his work, the student of Nature is painfully struck by the contrast, missing that indescribable something which life alone can give. Sea-birds' eggs are not bad eating when boiled for a long time, but they have a very strong flavour and are useless for delicate cooking. As for the flesh, though not absolutely uneatable, especially in a meat pie, there is something unpleasant in the thought of eating it, and on our English coasts few sea-birds are used to satisfy the human appetite, though the hardier and less squeamish Scotchman does not despise them preserved in salt. Of land birds Lundy has a fairly long list—blackbirds and song thrushes, skylarks, robins, meadow pipits, whitethroats, a few cuckoos, sparrows, chaffinches, and other common species being fairly numerous, while in severe weather considerable flocks of tender native birds cross from the mainland. In addition to the foregoing bird-life, plovers, curlews, peregrine falcons, Cornish choughs, ravens, gosshawks, carrion crows and buzzards are seen in small numbers; a pair or two of each species permanently residing on the island. The peregrine falcons of Lundy have always been in high repute for hawking, and even now young falcons are sent away for this purpose. An occasional eagle has condescended to alight on the island for a short rest. No more favourable place than Lundy could be found in June and July for the study of sea-birds. What life! What movement! What conflicting interests! In short, all the functions and habits of animals deserve investigation, and the bird lover should really pitch his tent on Lundy for a few months. In mild winters, Lundy weather is of a broken, spring-like character, and favourable to bird and insect life, but I never heard of swallows being seen there at that season.

Although the rocks look precipitous, and in places rise in abrupt ledges four hundred and even four hundred and fifty feet from the water, long practice and holding a rope in one hand, securely fastened to a crowbar driven into the ground, or firmly attached to a projecting point of rock, will enable a steady head and a keen eye to explore almost all the ledges, comparatively little of the side-lands being absolutely inaccessible. Nor is this amusement so dangerous as might be supposed, though lives have occasionally been lost. Ladies soon become expert climbers and find great excitement in exploring the nooks and crannies of the mysterious bays of the west and north-west.

Lundy has become a favourite shelter for thousands of ships in the course of every year, and it has probably saved many thousands of lives and hundreds of vessels. Unfortunately, in fogs it is often the cause of loss of life and destruction of property, and many a ship has gone down on its dangerous reefs and iron-bound sides. On the morning of Tuesday, February 6th, 1877, during my residence on the island, a large steamer, the "Ethel," of Sunderland, struck on a dangerous rock on the west side, not far from the Fog Signal Battery. The mate, a Scotchman, named John Lawrence, after a terrible struggle for life, swam ashore and was saved, his escape being simply miraculous. Had he not escaped it is very probable that the steamer to which he belonged would have

been lost sight of, and no certain information would ever have reached the world of its awful fate.

The population never can have been large, nor can fishing have brought immigrants from Cornwall and Devon. The want of a harbour is a fatal drawback, for though the anchorage is excellent and shelter can generally be found in the roughest weather, for many years there has not been, and perhaps there never was, any place where a small craft could count on absolute safety in all states of sea and wind; in other words, vessels could never have belonged to the island and stayed near it. The "shell-fish" is good, and a band of rugged Cornish fisher folk, from the remote coves of Land's End and Sennen, usually come over for some months every spring and summer, and manage to get large hauls of lobsters, which they take over to Ilfracombe or Instow for the London market. No life of greater peril and exposure and more continuous labour can be conceived than the fisherman's, and its rewards are small and precarious. The poor fellows lose their sleep, and work like slaves, and often end by perishing in storms, and all in return for very meagre wages. Deep-sea fishing must have a certain inexplicable fascination; at any rate no dearth of fishermen is feared, though the men who follow the calling do not seem particularly happy. They find a strange pleasure in relating their rather unromantic and monotonous experiences of wet and cold.

On the western side of the island there are many singular clefts or rifts, looking as though there had been some terrible convulsion of nature; this part of the island is called "The Earthquake," and tradition affirms that these clefts date from the catastrophe of Lisbon. Any connection between these rifts, this splitting of the granite—faults, as they would be technically called—and the Lisbon earthquake is as improbable as between them and the Battle of Waterloo. None the less, they are of singular grandeur and among the most wonderful of the many marvels of Mr. Heaven's little kingdom. In other places, too, the rocks are fantastically contorted, and look as though they had been uncouthly carved by laborious South Sea Islanders or Egyptian colonists. These natural sculptures are locally known by such appropriate names, for example, as "The Templar."

The antiquities of Lundy are not remarkable. Legends have been handed down of a dense population in ancient days, and of towns, villages and churches; but these have nothing to rest upon. Some brass guns, hurled down from an old battery on the sidelands, were said to be visible in the water at certain states of the tide on the east side, but I never saw them, though I often looked for them. Some kistvaens were found many years ago, but no description was published of them, and they are totally gone. Over a quarter of a century ago, too, some men, cutting a trench for a wall, came upon a curious grave of great antiquity, enclosing a skeleton, and the remains of eight or nine other human bodies were lying near. The skeleton in the grave is said to have measured 8 feet 3 inches, and a second was also of the abnormal size of 7 feet 10 inches. The improbability that these are correct measurements is so obvious that few scientific men would accept them as reliable. A lady generally living on the island, though temporarily absent, assured me that no mistake had been made, and that I could accept the measurements as trustworthy. Unfortunately, the attention of antiquaries was not drawn to the matter, and the skeletons were buried in the churchyard by order of the late squire. Some rude beads, apparently of glass, were found in or near the graves, and were preserved, and these were submitted to my learned friend, Dr. Ainsworth, who pronounced them Danish, but of no special value. The largest of the skeletons was enclosed in a rough stone grave, not a carefully constructed stone coffin, although a stone had been hollowed out for the head and another for the feet. If the beads were Danish one may assume that the bodies were those of Danes, and a curious inquiry might arise as to whether the ancient Danes buried their dead in the fashion described. The length of the skeletons is startling.

The present population is small, and though it rises and falls a good deal, has of recent years rarely exceeded fifty. Most of these people are connected with the extensive farm, comprising nearly all the cultivated land of the island; others belong to the Trinity House service, and a few to the squire's family. Some years before I took up my residence on the island, extensive quarrying operations were going on, and a large population was living there; the stone is said to be excellent. Accommodation for visitors is not abundant, and the squire does not like his little kingdom to be invaded. In summer, a fast steamer visits Lundy from Ilfracombe most weeks, and stops a few hours, and in this way an opportunity is afforded of exploring the place; a skiff also crosses weekly from Instow. Hard would it be to find another spot so cut off from the busy world, so interesting in its way, and yet so difficult of access. When I used to cross to Instow I felt once more in the bustle of modern life, though the first time I went to Lundy from Birmingham, directly after a journey to New York, Instow, where I was kept twelve days by the high seas, looked like the *ultima thule* of civilisation. Since I ceased to reside on the island, eighteen years ago, I have not set foot upon it, and the trouble and uncertainty of getting to and leaving Lundy explain my long absence,

although my interest in it is undiminished. I have, however, frequently seen it from Ilfracombe and Instow. Some of the residents still occasionally write to me, and though great changes have of late been made among them, they are not of such a character as to require any recasting of what I have said above.

Mr. Heaven could not do better than invite some famous field club to an *al fresco* existence of a week among the rocks of Lundy. What vegetable treasures they would unearth—what discoveries would make their visit memorable in scientific annals! And how greatly a born naturalist like poor Thomas Edward, of Low Shore, Banff, would enjoy a few months on Lundy.

Wimborne.

GREENWICH OBSERVATORY.

THE annual visitation of the Royal Observatory by the Board of Visitors took place on Saturday, June 4th. The Chairman of the Board, Lord Lister, the President of the Royal Society, being unable to be present, his place was filled by Professor Sir R. S. Ball. The visitors, other than the official Board, were perhaps not quite so numerous as in some former years. The chief centres of attraction to unofficial visitors were the Thompson Photographic Equatoreal and the New Alt-Azimuth instrument. During the past year the 26-inch object-glass of the equatoreal had to be sent back to Rathmines, Dublin, for improvement, and even now Sir Howard Grubb is engaged at the Royal Observatory retouching this glass. The 9-inch photo-heliograph was taken from over this instrument, and used by the Astronomer Royal, at Sahdol, Hindostan, in obtaining photographs during the solar eclipse in January last. These photographs were placed for exhibition and were of great interest. The photographic spectroscope has been completed, and fitted to the 30-inch Cassegrain reflector mounted opposite to the 26-inch on the same stand, but the reflecting prism to divert the light rays into the spectroscope is not yet put in position. The Alt-Azimuth instrument was got into working order in December, but it was only possible quite recently to commence regular observations, owing to the time absorbed in determining the errors of division in its circles, and also its stability. Discordances in the readings of the two circles were traced to the wheel carrying the reading microscopes having worked loose. This has been remedied; but, notwithstanding, there are some difficulties still to be surmounted in the reading of the azimuth circle in different positions.

During the year no less than 11,441 observations were made with the transit circle, without reckoning those made to rectify its adjustments. The Sheepshanks Equatoreal has been principally used in the observation of comets. The 28-inch has been employed in the micrometric measurement of delicate double stars, the size and shape of Neptune, and the position of its satellite.

The sun has been above the horizon during the year for 4,454 hours. The sunshine recorder at Greenwich indicates that he was shining 1,529 hours, that at Kew, 1,575 hours, and that at Bunhill Row, in London, 1,279 hours. Either at Greenwich, India, or Mauritius, photographs of the sun have been obtained on 364 days out of the 365. On forty-two days no spots were recorded, against six without spots in the previous year. The day of the visitation itself was one without sun spots, whilst small groups were on the disc both on the preceding and succeeding days.

With the 13-inch photographic charting telescope 526 plates were taken, but 107 had to be rejected from various causes. An unfortunate discovery has, however, been made that many of the earlier plates for this chart have been injured by damp.

The site for the new Magnetic Pavilion is about three hundred and fifty yards east of the present observatory, and it is hoped that it will be built during this summer. The mean temperature for the year was 0·9° above the average of the fifty years 1841-90, a result of the mild winter. The recorded rainfall was only 17·33 inches, which is 7·2 inches less than the average fall for fifty years. During that period only one year, 1864, had a smaller fall, the record being 16·33 inches.

FRANK C. DENNETT.

BENEATH THE DEVIL'S DYKE.

HOWEVER bare and treeless may be the rolling downs of Sussex—in this respect so greatly in contrast to the Surrey Downs—one occasionally lights upon a sheltered hollow at the foot of the escarpment on the north, where a few feet of loamy chalk soil allows of the growth of a picturesque bit of woodland. Such an one is to be found at the mouth of that gap in the South Downs which runs out on to the Weald at Poynings, and which is known as the Devil's Dyke. The junction in this gap of the chalk with the chalk marl is marked by a small oozy tract, whence issue some springs, which uniting form a brook of no mean dimensions. A lovely little oasis of verdure is found for about a couple of hundred yards, where the soil is fertilized by this life-giving brook. Here forest trees of respectable height clothe the sides of the valley. Though well into June, the hawthorn (*Crataegus oxyacantha*) this year is in full blossom, and underneath the trees the pink and crimson campions (*Lychnis diurna*) are drawn up for three feet or more. In the soft

oozy soil the watercress (*Nasturtium officinale*) has a precarious foothold and is showing its little white blossoms, whilst where the brook has gathered strength, a little lower down, the brooklime (*Veronica beccabunga*) marks its otherwise hidden course. But the most attractive feature of this beautiful spot is the quantity of common comfrey (*Symphytum officinale*) which grows in the marly mud. In white and purple there hang the drooping bell-like flowers in plenty; there is no lack of them, and they are growing to a height of four feet or more, every plant the bearer of dozens of blossoms, and each cluster being seemingly veiled by a leaf running concurrently with the stem. The comfrey is not alone, for crowding it for possession of the fertile mud, is a small forest of young horsetails (*Equisetum*), a degenerate descendant of the ancient carboniferous calamite. On the banks at both sides of the stream, which has here broadened out, the wood has been considerably thinned. In this undergrowth at the foot of the Dyke Hill, I counted upwards of fifty specimens of the twayblade (*Listera ovata*), all in the space of about half an acre. A similar profusion I found a day or two later in respect to the same species at Clayton. The only other orchidaceous plant which I met with was the fly-orchis (*Ophyris muscifera*), of which I found two specimens. As, however, I went westward towards the vertical railway, I came across two specimens of the spotted orchis (*Orchis maculata*), but neither of these were yet fully developed. Many plants seem later than usual this year. The common bush-vetch (*Vicia sepium*) is seen in quantities in the hedges, whilst already in blossom is the white bryony (*Bryonia dioica*) scaling the hedges by means of its tendrils. Black bryony (*Tamus communis*) is there too, perhaps in greater profusion, its shiny leaves all turned outward as it twines in and out amongst the brambles and the sloe bushes.

Although I put pen to paper to call attention to this lovely little spot, I would just refer to the profusion of yellow rattle (*Rhinanthus crista-galli*) which I noticed above the Dyke Railway Station, two miles away. The upper petal is peculiarly marked with two spots of violet. Some of the calyces were already inflated with seeds.

EDWARD A. MARTIN.

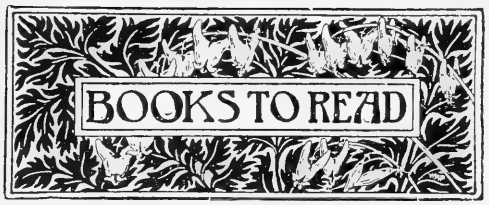
THE proprietors of "The Times" have done a good work in reissuing the last edition of "Encyclopædia Britannica" on such exceedingly favourable terms. By paying down one guinea the twenty-five volumes are delivered, the balance being at a guinea a month afterwards. This valuable book of reference may now thus be obtained for fourteen guineas. It was originally issued at thirty-seven pounds. There are numbers of articles on scientific subjects, written by men of known experience and special knowledge in their various departments.

NEW WORK ON LEPIDOPTERA.

MR. J. W. TUTT, F.E.S., is passing through the press a new work on Lepidoptera. It is to be devoted to a critical examination of the order, especially as represented in Europe, and will include the divisions of Macro-lepidoptera and Micro-lepidoptera. It is expected to appear early in the autumn. The author is publishing it by subscription at 15s. the volume before issue, and one guinea afterwards. The chief feature of this work will be a new scheme of classification based entirely on recent research by Drs. Dyar and Chapman. This is well-known to advanced entomologists, and is of great scientific importance. We may therefore expect some remarkable changes in the direction of the study of the order. The preliminary chapters of the book will consist of (1) The Origin of Lepidoptera, (2) The Lepidopterous Egg and its Evolution, (3) Parthenogenesis, (4) The Embryology of a Lepidopterous Insect, (5) The External Structure of the Lepidopterous Larva, (6) The Internal Structure of the Lepidopterous Larva, (7) The Variation of the Imagines of Lepidoptera, (8) Defensive Structures and Protective Coloration of Larvae, (9) Classification of Lepidoptera. These chapters occupy about 112 pages of the work. The second part of this work will consist of a monograph of the Sphingo-Micropterygid Stirps, of the Micropterygid and Nepticulid moths, the Eucleides, the Anthrocerides, the Psychides, the Lasiocampides, the Saturniides, Endromides and Sphingides. This part is well forward, in fact nearly completed. Mr. Tutt has received important assistance from several of the leading British lepidopterists who study the order from the point of view of an exact science. The volume is expected to occupy upwards of 400 pages; each volume will be complete in itself. Intending subscribers should apply direct to Mr. Tutt, Rayleigh Villa, Westcombe Hill, London, S.E.

[In consequence of an oversight the above notice, which appeared in SCIENCE-GOSSIP last month on page 17, was inserted without correction. This having been done, we reprint it, rather than give the numerous alterations without the context.—*Ed.* SCIENCE-GOSSIP.]

HENRY LEWIS. — This well-known student of early civilization of man and expert in prehistoric flint implements was born sixty-four years ago at Walworth, and died at Wandsworth on April 10th last. He was brought up to be a shoemaker, but soon developed a taste for the study of natural history. This led him to searching gravel pits in the Thames Valley and elsewhere, especially in many parts of eastern England, where he found large numbers of the worked-flint remains of our ancestors, not only as flakes but also as finished implements. Aylesford formed his latter base of investigation, where he obtained much interesting material. He wrote little, but has left a large mass of examples to be worked out and described.



NOTICES BY JOHN T. CARRINGTON.

William Stokes, His Life and Work. By his Son, WILLIAM STOKES. 239 pp. 8vo, with 3 plates. (London: T. Fisher Unwin, 1898.) 3s. 6d.

This is the fourth of the series of biographies of masters of medicine, inaugurated by the late Dr. Ernest Hart, who was to have edited them. In writing the biography of his father, Sir William Stokes has naturally been handicapped by his close relationship, fearing that too much eulogy would be misconstrued by some persons for personal affection. The interval of twenty years since the death of the celebrated Dr. Stokes, and the discretion of the author of the book before us, renders such accusation impossible. To our numerous medical subscribers the work of Dr. Stokes is as household words, so well is it known, and so eminent was he as a pioneer in his profession. To the more general public the volume appeals for many reasons, not the least being the glimpses obtained of Ireland and Irish society about the time of its saddest and most depressed period—from 1825 to 1870. For the readers of SCIENCE-GOSSIP are to be found many touches of nature-lore and science; and for all, the remarkable word-pictures, written by Dr. Stokes, of his home surroundings and impressions whilst travelling. His leanings towards scientific knowledge extended beyond his own profession, and included natural history, especially botany, zoology, mineralogy and chemistry. The taste doubtless came from his father, who had similar inclinations. The father, Dr. Whitly Stokes, took an active part in the foundation of the Dublin College Botanical Gardens and the Zoological Gardens, of that city. Sir William Stokes has written a most readable book, pleasingly interspersed with facts and amusing anecdotes.

The Pruning-Book. By L. H. BAILEY. 540 pp. 8vo, with 331 illustrations. (New York: Macmillan Company. London: Macmillan and Co., Ltd., 1898.) 5s. net.

The author very properly describes this work as a monograph of the pruning and training of plants as applied to American conditions; and it is an excellent treatise on the subject. With few exceptions, his remarks apply equally well to Europe. With the aid of this book, any intelligent person should be able to manage perhaps the most important section of a garden. Mr. Bailey's style is simple but convincing. The figures are admirable, as they illustrate not only the best ways of pruning and training, but also the bad and what is to be avoided. It is quite a book for the country house, and will also be useful to the suburban gardener.

Ackworth Birds. By Major WALTER B. ARUNDEL. 113 pp. 8vo. (London: Gurney and Jackson, 1898.)

The district of Ackworth in Yorkshire is near Pontefract. It is undulating and well wooded in places. Major Arundel has recorded in all 149 species of birds, eighty of which breed regularly within his region. The arrangement and nomenclature followed is that adopted by Mr. Howard Saunders in his Manual. The English names are given, and also a number of local names. It is a good list, carefully prepared, and one likely to stimulate a taste for scientific ornithology in the district, besides being useful to the more advanced students in regard to the distribution and nesting habits of birds.

List of Fossil Cephalopoda in the British Museum. By G. C. CRICK, F.G.S. 105 pp. (London: Trustees of British Museum.) 2s. 6d.

This catalogue contains a list of all the known types and figured specimens of Cephalopoda so far as known on its compilation on 23rd of March last. It is a list, in the first place, of those species in the British Museum (Natural History), but it is more, as it contains localities and many useful references to the fossil cuttle-fish and their allies in other collections.

Catalogue of Welwitsch's African Plants. Part iii. By WILLIAM PHILIP HIERN, M.A., F.L.S. pp. 337 to 510. (London: The Trustees of the British Museum, Natural History Department, 1898.) 4s.

This part of the descriptive catalogue of plants collected in Africa by Dr. Friedrich Welwitsch in 1853-61, includes Combretaceae to Rubiaceae. These admirable Museum publications may be obtained direct from the Museum in Cromwell Road, London, or through such publishers as Longmans, Quaritch, Dulau, or Kegan Paul.

Elementary Practical Zoology. By FRANK E. BEDDARD, M.A., F.R.S. 214 pp. crown 8vo, with 93 illustrations. (London, New York and Bombay: Longmans, Green and Co. 1898.) 2s. 6d.

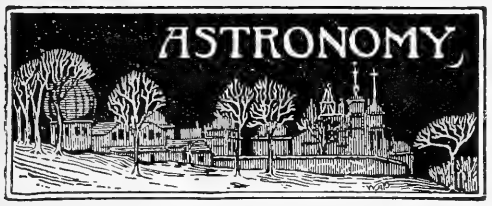
The author is so well known as a trustworthy teacher and investigator of animal life that the publishers could not have chosen a safer hand for producing a text-book on Zoology for their "Practical Elementary Science Series." We need hardly remind our readers that Mr. Beddard is Prosector to the Zoological Society of London, Lecturer on Biology at Guy's Hospital, Examiner in Zoology and Comparative Anatomy in the University of London, etc. He is therefore especially qualified to write such a work as the one before us. Its object is to provide a guide to the elementary zoology required by the Science and Art Department in their examinations. It embraces all the types comprised in the syllabus issued by the Department, besides much other useful matter. The author treats his subject as dealt with by the Science and Art Examiners, therefore the book will be invaluable for students preparing for those examinations.

Journal of the Marine Biological Association of the United Kingdom. New Series, Vol. v. No. 2., pp. 107-233. (London: Dulau and Co., 1898.) 3s. 6d.

These are several important papers founded on work done at Plymouth, in the April issue of this journal, and some interesting notes. Among the former are two by Messrs. E. W. L. Holt and S. D. Scott on "The Reproduction and Early Stages of Teleostean Fishes," one on "Keeping Medusae Alive in an Aquarium," by Mr. E. T. Browne, and another by the same observer on "The Pelagic Fauna of Plymouth" for September, 1897.

Proceedings of the South London Entomological and Natural History Society. 1897. Part ii. (London: The Society, 1898.) 2s.

This part contains the excellent presidential address delivered by Mr. R. Adkin, and several papers of some importance, with illustrations.



CONDUCTED BY FRANK C. DENNETT.

	1898. July.	*Rises.* *h.m.*	*Sets.* *h.m.*	*R.A.* *h.m.*	*Dec.*	*Position at Noon.*
Sun	1	3.49 a.m.	8.18 p.m.	6.42	23° 6′ N.	
	11	3.57	8.13	7.23	22° 5′	
	21	4.10	8.2	8.3	20° 26′	
	31	4.24	7.48	8.43	18° 13′	

	July.	*Rises.* *h.m.*	*Souths.* *h.m.*	*Sets.* *h.m.*	*Age at Noon.* *d. h.m.*
Moon	1	6.19 p.m.	10.1 p.m.	0.49 a.m.	12 7 41
	11	11.8	6.10 a.m.	1.47 p.m.	22 7 41
	21	7.4 a.m.	2.4 p.m.	8.48	2 16 13
	31	6.49 p.m.	10.54	1.42 a.m.	12 16 13

	July.	*Souths.* *h. m.*	*Semi Diameter.*	*R.A.* *h.m.*	*Dec.*	*Position at Noon.*
Mercury	1	0.10 p.m.	2″ 5	6.49	24° 24′ N.	
	11	1.0	2″ 6	8.17	21° 35′	
	21	1.32	2″ 9	9.29	16° 8′	
	31	1.47	3″ 3	10.23	9° 53′	
Venus	1	2.28 p.m.	6″ 5	9.6	18° 30′ N.	
	11	2.35	6″ 9	9.53	14° 38′	
	21	2.40	7″ 3	10.37	10° 10′	
	31	2.43	7″ 8	11.19	5° 19′	
Mars	11	8.13 a.m.	2″ 7	3.30	18° 14′ N.	
Jupiter	11	4.55 p.m.	16″ 1	12.14	0° 6′ S.	
Saturn	11	9.0 p.m.	8″ 3	16.19	19° 35′ S.	
Uranus	11	8.31 p.m.	1″ 9	15.51	19° 58′ S.	
Neptune	11	10.14 a.m.	1″ 2	5.31	22° 0′ N.	

MOON'S PHASES.

		h.m.			*h.m.*
Full	July 3	9.12 p.m.	*3rd Qr.*	July 10	4.43 p.m.
New	,, 18	7.47 ,,	*1st Qr.*	,, 26	1.40 ,,

In perigee July 3rd, at 2 p.m., distant 222,000 miles; in apogee on 19th, at 5 p.m., distant 252,500 miles; and in perigee again on 31st, at 11 p.m., distant 223,600 miles.

CONJUNCTIONS OF PLANETS WITH THE MOON:

July 1	Saturn*†	3 p.m.	planet	5° 20′	N.
13	Mars*	9 p.m.	,,	4° 56′	S.
20	Mercury*	7 p.m.	,,	4° 16′	N.
22	Venus*	11 a.m.	,,	5° 55′	N.
24	Jupiter*	3 p.m.	,,	6° 59′	N.
28	Saturn	10 p.m.	,,	5° 18′	N.

* Daylight. † Below English horizon.

OCCULTATION AND NEAR APPROACH:

July	*Star.*	*Magnitude.*	*Disappears. h.m.*	*Angle from Vertex.*	*Reappears. h.m.*	*Angle from Vertex.*
28	σ Scorpii	3	10.19 p.m.	340°	Near ap.	
30	λ Sagittarii	3·1	7.31 p.m.	98°	8.41 p.m.	283°

THE SUN usually has one or more groups of small spots upon its disc. The earth is farthest from him at 2 p.m. on the 2nd July.

MERCURY is an evening star, at the end of the month setting nearly an hour later than the sun. At 10 a.m., on the 27th, he is in conjunction with α Leonis (Regulus), which is 0° 0′ S., and therefore in the same telescopic field.

VENUS is a brilliant object after sunset. At the beginning of the month she sets nearly two hours later than the sun, and at the end of the month about one hour twenty-five minutes later.

MARS rises at 0.54 a.m. at the beginning of July, and at 11.48 p.m. at the end of the month.

JUPITER sets at 11.36 p.m. at beginning of the month, and at 9.49 p.m. at the end, so should be looked for early in the evening.

SATURN and Uranus are unfortunately too low in declination south for very delicate observation, though otherwise fairly placed, being above the horizon nearly all the evening, Saturn setting just before midnight at the end of the month.

NEPTUNE is too close to the sun for study.

METEORS may be specially looked for on July 11th, 20th, 21st and 25th to 30th.

ECLIPSE OF THE MOON.—A partial eclipse of the moon occurs on July 3rd. The first contact of the moon with the penumbra is at 6.48 p.m., and with the shadow at 7.46. The last contact with the shadow is at 10.49, and with the penumbra at 11.47. The first contact with the shadow commences 49° from the north point of the moon's limb toward the east, and the last 70° from the same towards the west. As the moon does not rise at Greenwich until 8.18 p.m. only the latter part of the eclipse can be visible from these islands. At the middle of the eclipse, 9.17·5, the magnitude of the eclipsed portion will be 0·934.

ANNULAR ECLIPSE OF THE SUN.—This happens on the evening of July 18th, but is invisible in England, the favoured portion of the world being the southern hemisphere.

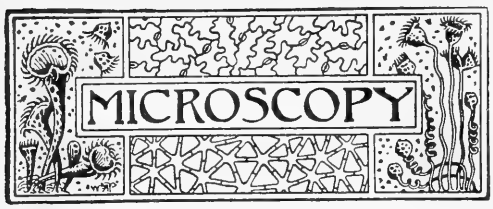
"THE SECOND MOON OF THE EARTH."—July 30th is the day predicted for the transit of this supposed body across the disc of the sun. Of course our readers interested in these matters will keep a sharp look out on that day, weather permitting, and they will see—what they will see.

THE Lick Observatory is losing the services of Professor J. M. Schaeberle, who has resigned.

TOTAL SOLAR ECLIPSE OF 1900, May 28th, is already drawing attention. Messrs. G. F. Chambers, W. H. Wesley, Crommelin and Newbegin made remarks about it at the meeting of the British Astronomical Association on May 23rd. The line of totality crosses Portugal, Spain and Algiers, and so the phenomenon is within easy access of observers in this country.

THE greatest proper motion known until recently was that of the 7th-magnitude star, Groombridge 1830, on the borders of Ursa Majoris and Canes Venatici, and which amounted to 7″·0 of a great circle per annum. Professor Kapteyn announced, however, in the "Astronomische Nachrichten," No. 3,466, the discovery by himself and Mr. R. T. A. Innes, of a motion equal to 8″·7 of a great circle, in the case of an orange yellow star just below 8th magnitude, in the Cordoba Zone Catalogue, in the constellation Columba.

MR. HERBERT SADLER, the eldest son of the late Prebendary Sadler, of Honiton, Devon, was elected a Fellow of the Royal Astronomical Society in 1876. When the shortlived Selenographical Society was formed, in 1878, he was elected its secretary. He helped much in bringing out the fourth edition of the amateur astronomer's *vade mecum*, Webb's "Celestial Objects for Common Telescopes." For some years past he has contributed the monthly "Face of the Sky" to our contemporary "Knowledge." On June 1st acute bronchitis very suddenly made him its victim at the all too early age of forty-two. The writer feels deeply the loss of a personal friend, who spared no pains, if he could render help, in giving or seeking out information in astronomical matters, and that on many occasions during the past twenty-two years.



CONDUCTED BY J. H. COOKE, F.L.S., F.G.S.

To whom Notes, Articles and material relating to Microscopy, and intended for SCIENCE-GOSSIP, *are, in the first instance, to be sent, addressed "J. H. Cooke, Edlestone, Battenhall Road, Worcester."*

NOTICES AND REVIEWS.—We shall be glad to notice all books, papers, reports, bulletins, periodicals, etc., within the scope of the "Microscopy" section, which may be sent to us for that purpose.

MICROSCOPICAL TECHNIQUE.—Professor G. C. Huber, of the University of Michigan, is contributing a series of useful articles on "Microscopical Technique" to the columns of the "Journal of Applied Microscopy." In the current number he deals with "The Hardening of Tissues for Microscopical Examination."

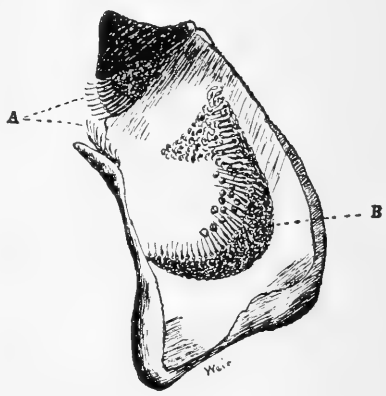
THE AMERICAN MICROSCOPICAL SOCIETY will hold its next meeting on August 30th and 31st, and September 1st, 1898, at the University of Syracuse, N.Y. It is expected that the Congress this year will be largely reinforced by members of the American Society for the Advancement of Science, who are holding their meeting a few days before at Boston.

A STUDENT'S MICROTOME.—In selecting a microtome, the main considerations with the majority of students are cheapness, general applicability, ease of manipulation, and durability. The difficulty hitherto has been to find an instrument that combines all of these desiderata. There are plenty of microtomes on the market, but, as a rule, the price is much above the average student's means. To supply what was a manifest want, Messrs. Reynolds and Branson, of Leeds, have just introduced an instrument which combines all of the above requisites, and which is so simple and practical that it has been introduced into the Leeds Medical School. We have had an opportunity of trying one of these instruments, and while cordially recommending it, we have no hesitation in saying that no better value has ever been offered for the money. As will be seen from

REYNOLDS AND BRANSON'S STUDENT'S MICROTOME.

the illustration, the instrument is arranged to slide on a glass plate with a circular roughened ring, the substance to be cut being imbedded and fixed on that plate. Sections of any degree of thickness may then be cut by simply raising or lowering the screw. The microtome is so arranged that any razor may be clamped to it, and it will be found extremely useful to students in physiology, botany, etc. The price of the microtome, with glass plate, is only 4s., and razors are supplied at 1s. and 2s. each.

A LOBSTER'S EARS.—The ears of a lobster are to be found at the bases of its antennae, each of which terminates in a *cul de sac*, or pouch. The external covering of skin of these pouches is a continuation of the body covering, though somewhat modified in structure. In each pouch are always to be found several minute grains of sand, and these grains of sand play prominent rôles in the drama of audition. The microscope shows that the floors of the ear pouches are papilomatous, or dotted thickly with minute papules, or elevations, each surmounted by



EAR OF LOBSTER (modified from Farre).
A, Orifice; B, auditory hairs and sandgrains.

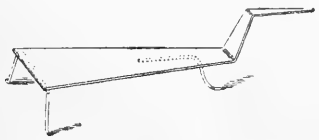
a hair. If one of these papules be examined, a terminal nerve-tuft will be found ensheathed in its thin walls; a microscopic nervule leads from it, together with thousands of its fellows, to the auditory nerve, which passes on into the sensorium. This description of a lobster's ear is derived from a careful study, by Dr. J. Weir, of fresh specimens.

CIRCULATION OF BLOOD.—The standard method of examining the circulation is that of extending on a frog-plate the web between the toes of a frog's foot. As, however, most amateur microscopists find it difficult to obtain a frog when they require one, it might be of advantage to some of them to know that the tadpoles of the common frog form excellent substitutes during their embryonic state, and that in the thin expansion of the tail the circulation is exhibited to perfection. These tadpoles are easily obtained in almost any district, and may be kept in a small aquarium or fish globe, where they will be handy when required. The method of examination is very simple. The tadpole is caught and transferred to an ordinary slide, and a lump of loose wet cotton-wool is placed over it, holding it down fast to the slide, and leaving the tail free for observation. If there is any tendency to curl the tail up on to the object-glass, an ordinary thin glass cover may be placed over it to keep the tail steady. The tadpole can be kept thus for an hour or more without any apparent discomfort, provided that the cotton-wool be kept moist. It might be mentioned that the tadpoles are of very little use for this object after the development of the legs, as the circulation then ceases, and the tail becomes opaque. I always use a one-inch objective and dark ground illumination. —*Lewis H. T. Chave, Weymouth.*

DIRECTORY OF MICROSCOPISTS.—The editors of "The Journal of Applied Microscopy" invite all interested in biology, histology, pathology, petrography, and any persons engaged in microscopical work, to express an opinion as to the advisability of issuing, as far as possible, a complete directory of microscopists in 1899. Such a directory would furnish a ready means of communication between the users of the microscope in various parts of the world, so that exchanges of material and experience might be effected. If Messrs. Bausch and Lomb, of Rochester, N. Y., receive sufficient encouragement it will be commenced forthwith. We recommend the venture to the notice of our readers.

HOLIDAY MICROSCOPY.—By this time most of our readers will have once again got their collecting-bottles and nets into working order and will have recommenced their studies of the microscopic life of the ponds and ditches in the neighbourhood. *Nitella* and *Chara* are now to be found in their full vigour in pools and shady woods, and *Spirogyra* and other freshwater algae are in full fruit in the ditches and runlets. For the student of marine life the sea grass *Zostera marina* affords an abundant harvest of interesting parasitic species of algae on its leaf-tips, and the Fuci and Laminarias present many interesting object lessons in problems of growth. In the shallow ditches by road-sides diatoms flourish, and on the crests of the ripple-marks left by the receding tide a rich harvest of the Foraminifera may be gathered.

PARAFFIN IMBEDDING TABLE.—Another form of paraffin imbedding table recommended by Mr. H. B. Ward in the same journal is made of a

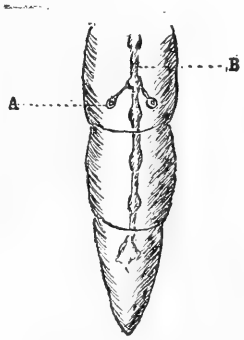


PARAFFIN IMBEDDING TABLE.

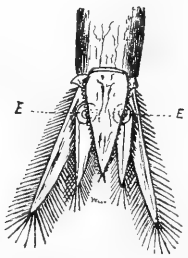
triangle of sheet copper, with a base of six inches and a perpendicular height of fourteen inches. The edges of the triangle are turned under and inward, giving to the table a smoothly rounded margin. In height, the main part of the table measures two inches, and it is four inches high under the apex of the triangle, where is placed the heating flame, which may be gas, or oil, or alcohol lamp.

PHOTO-MICROGRAPHY WITH HIGH POWERS.—In "Nature" Messrs. J. E. Barnard and T. A. B. Carver explain how they have overcome the difficulty experienced in photo-micrography with high powers and critical illumination, owing to the unequal intensity of the light emitted from the surface of incandescent limes, or the impossibility of controlling the electric arc so as to maintain a constant position and condition of the crater on the positive carbon. The latter difficulty has now been overcome by having a simple form of hand-feed apparatus, with a pinhole camera attached, through which an image of the carbon points is projected on to a ground-glass screen. With such a form of arc-lamp absolute "centration" of the light can be secured and maintained, without reference to the microscope, after the necessary position of the image of the arc on the screen of the pin-hole camera has been once obtained.

THE EARS OF WORMS AND ANTS.—Dr. J. Weir has recently been carrying on some interesting investigations in connection with the ears of worms, crustaceans and ants, and he has concluded from these that many of the lower animals are capable of hearing sounds whose vibrations are so many or so few per second that the human ear is unable to perceive them. He has demonstrated the fact that ants can hear sounds that are produced by vibrations exceeding 10,000 per second. The lowest

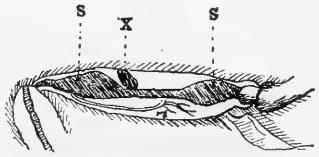


AUDITORY ORGANS OF EARTHWORM (*L. terrestris*). A, Auditory organ; B, noto chord.



TAIL OF SHRIMP. E, Auditory organs (after Lubbock).

sound that the human ear can detect is produced, probably, by about twelve vibrations per second. He has extended his observations to the auditory organs of worms, and in the "Scientific American" he describes the *modus operandi* of his experiments. If the third caudal segment of a common angle worm be frozen and a thin section of its lower surface be placed beneath a low-power lens, two oval pinkish bodies lying immediately beneath can be readily made out. When the section is stained with eosin, these little organs become quite visible even to the naked eye. Two nerves start from these bodies, one from each, and end in a ganglionic enlargement of the noto chord or central nerve. Reasoning by exclusion and analogy, and comparing with the shrimp, whose ears are in its tail, Dr. Weir concludes that these bodies are the worm's organs of hearing. The ears of ants are situate in their legs. If an ant's leg be examined,



TIBIA OF ANT (*L. flavus*).
S S, Swellings of large trachea; X, chordotonal organ.

a curious enlargement of its canal will be at once observed. In the femur or thigh the diameter of this canal is $\frac{1}{3000}$ of an inch, but when it enters the tibia it swells to $\frac{1}{500}$ of an inch. In the upper part there is a conical striated organ which bears some resemblance to the organ of corti in the human ear. This constitutes the auditory organ of the ant. Dr. Weir's paper is most suggestive and instructive, and it contains in some detail descriptions of the various experiments upon which his conclusions are based.

GEOLOGY

CONDUCTED BY EDWARD A. MARTIN, F.G.S.

To whom all Notes, Articles and material relating to Geology, and intended for SCIENCE-GOSSIP, *are, in the first instance, to be addressed at* 69, *Bensham Manor Road, Thornton Heath.*

TO FIELD GEOLOGISTS.—It is hoped that our readers, now that the season is favourable for the pursuit of outdoor geology, will remember that we are always pleased to receive notes, for publication, of their own finds in the field. Two men enter a quarry, but each reads the record of the rocks in a different way. A geologist studies one quarry on successive occasions, but the face of the quarry is constantly changing, and the finds are certain to be correspondingly different. Lists of fossils from a given stated locality are always useful. Local geological lore constitutes the very backbone of the science. Good topographical knowledge is an essential in describing local geological facts, and it is the local geologist who, as a rule, possesses this knowledge. We shall always be glad to hear from our geological readers.

HISTORY WRITTEN IN MINERALS.—To a study of records, that we are just beginning to recognize, M. J. Thoulet has given the name of "Paleominer-alogy." This branch of geological study shows that important facts concerning the earth's constitution or geography in past epochs are to be read from the traces of events in minerals, such as are illustrated by the formation of liquid inclusions in crystals, the optical deformation that shows whether felspar has been red-hot, and the wearing of pebbles. Through the character of the sand the dunes of Holland were traced to the Scandinavian rocks. The shapes of sand-grains are found to bear certain relations to the distance they have been transported and the velocity of the current that carried them. It is suggested that some day we may read such lessons so thoroughly as to be able to determine from a piece of limestone the dimensions of the sea in which it formed, with the force and direction of its currents and winds, and the depth, temperature, salinity and density of its water.—*J. H. Cooke, Edleston, Worcester.*

RUDISTES IN BRITAIN.—The order of molluscs which was named Rudistes by Lamarck has yielded but few specimens in our English chalk. In France, Spain, Greece and other countries bordering on the Mediterranean, *Hippurites* and *Sphaerulites* are common and characteristic genera of cretaceous beds, but are very rare in our native beds. One specimen of *Radiolites mortoni* was obtained many years since from the chalk of Houghton, in Sussex. Another was found at Dover, in the zone of *Rhynconella cuvieri*, by Mr. Griffiths, of Folkestone. It occurred just above the "Grit Bed" of Mr. F. G. H. Price, F.G.S., which is itself placed at the base of the Middle Chalk (Turonian).

THE ELEPHANT IN CHESHIRE.—Mr. G. H. Morton, F.G.S., records (Trans. L'pool. Biol. Socy., vol. xii., 1898) the finding of the femur of *Elephas primigenius*, in 1803, in the Boulder Clay near the village of Wrenbury; a tooth and lower portion of a humerus from Sandbach, Cheshire, by Mr. J. B. Aspinall; a tooth from the sand and gravel pit at Marbury, found by a workman in 1877, and now in Mr. Morton's possession. Professor Boyd Dawkins records *Elephas antiquus* from Coppenhall in Cheshire. All of these are from the Middle Sands of the glacial deposits, representing an interval when the sea was comparatively clear of ice, which, according to the author, deposited the Boulder Clays above and below the Sands. The Rev. T. W. Norwood has collected about twenty species of molluscs from the Middle Sands at Marbury. The teeth and bones are thought to be of Pre-glacial age, having drifted to their present sites from the caves of Derbyshire and North Wales.

CROYDON FOSSILS.—Amongst the specimens exhibited at the Congress of Scientific Societies at Croydon, 1898, were some interesting chalk fossils from Haling Pit, the pit whence the famous Purley Boulder was derived. These included a piece of coniferous wood in flint, showing bordered pits, the second recorded specimen of *Synhelia sharpeana*, and a tooth of *Notidanus microdon*. From Whyteleafe were *Cestracion rugosus* (Middle Chalk), two of six specimens known, an abnormal specimen of *Echinocorys vulgaris (ananchytes)*, and a large tooth of *Lamna sulcatus*; all exhibited by Mr. G. E. Dibley, F.G.S. From the Mitcham gravels were bones or antlers of *Cervus*, *Bos*, *Equus*, *Elephas*, exhibited by Mr. J. Hall; and from the Woolwich Beds of Park Hill cutting were oysters, *Cyrenae*, and other characteristic fossils, shown by Dr. Parsons.

A NEW GEOLOGICAL MAP OF ENGLAND AND WALES.—A publication of considerable importance to geologists is the new geological map of England and Wales, which has just been issued under the superintendence of Sir Archibald Geikie. (The Edinburgh Geographical Institute. Price 12s. 6d., or on cloth, with rollers, varnished, 17s. 6d.) The topography is by Mr. John Bartholomew, F.R.G.S., and is reduced from the sheets of the Ordnance Survey on the scale of ten miles to an inch. Sir Archibald acknowledges in his introductory note assistance rendered by the late Mr. W. Topley, F.R.S., also by Messrs. H. B. Woodward, W. Gibson, Bosse, and W. W. Watts. He points out that hitherto the best available map has been that published in 1859 by the late Sir A. C. Ramsay, on a scale of twelve miles to the inch, this map being a reduction from the Survey maps, so far as these had then appeared. Its topographical basis was not, however, sufficiently accurate for the production of a wholly satisfactory geological map. It is also pointed out that the Geological Survey began in 1835, and has now completed, the mapping of the whole country on the scale of one inch to a mile, and is issuing a reduction on the scale of four miles to an inch. The map now under notice is accompanied by a descriptive text of 28 pages, intended for the use of the general reader or traveller who may have no special geological knowledge. We notice that those portions of Ireland, Scotland and France which are shown are also conveniently geologically coloured. The map is thoroughly up to date, and constitutes a serviceable companion to the intellectual tourist who wishes to know something of the ground over which he passes. We notice, for instance, the Pliocene beds of Kent are shown, the Eocene patches which are found scattered

over the chalk of the North Downs and the Chiltern Hills, and the extension of the Lower Greensand in patches over the oolites in Buckinghamshire. The outcrops of the secondaries throughout the Midlands are faithfully portrayed in all their meandering and almost confusing details. A series of four horizontal sections, which are given, will be of great value to our readers. They are coloured geologically, and are as follows: (1) across England and Wales from Holyhead to Beachy Head; (2) across the centre of England from Denbigh over the Cheshire Plains, the Derbyshire Hills, and the Plains of the Trent, to the coast of Lincolnshire at Saltfleet; (3) from the Solway across the Lake District and the Pennine Chain, to Yorkshire at Flamborough Head; (4) section across the Isle of Wight. We would venture to express an opinion that the map would possibly be more serviceable if it were not fastened into the cover containing the "Explanatory Notes," as these render the top left-hand corner of the map inconveniently weighty when it is extended.

WERNER AND HUTTON.—On reading Mr. Edward A. Martin's review of Geikie's "Founders of Geology" (*ante* p. 11), the fact was suggested that Sir Archibald's criticisms anent Werner might be very truly and justifiably applied to certain other "founders" whom he extravagantly extols. Of Werner it is averred that "what was true in doctrine was borrowed from his predecessors, what was his own consisted largely of unwarranted assumptions." The influence of the man who "put back the geological clock for half a century" might have been disastrous to the higher interests of geology; but I have never heard that he positively set his face against or scouted any of the methods of research which we now know to be truly scientific and solely adapted to the discovery of truth. What about James Hutton, the author of the extravagant theory which was so rhetorically defended by Professor Playfair, whom Geikie so fulsomely extols? When Sir James Hall essayed to perform some fully correct and admirable experiments on the fusion of rocks, etc., he was sharply pulled up by his theorizing master, Hutton, who deeply mistrusted any attempt "to judge of the great operations of Nature by merely kindling a fire and looking into the bottom of a little crucible." After this, indeed, one might well wonder if we had quite got beyond the age of Bacon and the despised schoolmen of the middle ages. A very humble and obscure student of geology, provided, of course, that he was endowed with the faintest scientific intelligence, might well exclaim, "surely the man who scouted experiment was nothing but an imaginative theorizer, backed up by a rhetorical declaimer; his influence, indeed, must have been truly disastrous to the higher interests of geology." But not so the Director-General of the Geological Survey. He exhorts every young student to read and re-read, and read yet again, the consummate masterpiece of geological rhetoric penned by Prof. Playfair, a copy of which, I understand, cannot be found in the geological library of the Natural History Museum. I therefore entirely fail to see the justice of the distinction herein set forth. Werner's exertions effected something for geological classification; but I have yet to learn what Hutton did that a little experiment and less rhetoric might not have far more fully and satisfactorily accomplished.—(*Dr.*) *P. Q. Keegan, Patterdale, Westmoreland.*

HENRY PERIGAL.—Longevity has undoubtedly been a feature of the Perigal family. The subject of this notice died on June 6th at the advanced age of ninety-seven years. His father lived to upwards of ninety-nine years, being one of thirteen children, nine of whom reached the remarkable collective age of 750 years, three of them totalling 291 years. Henry Perigal was to the time of his death the treasurer of the Royal Meteorological Society, a Fellow of the Royal Astronomical, Royal Microscopic, and some other scientific societies and clubs, which he regularly attended up to somewhat more than a year ago. Mr. Perigal wrote various works on divers scientific subjects, his tendency being mathematical. They include astronomy, bicycloidal and other curves, kinematics, the laws of motion, probable mode of constructing the pyramids, etc. It is only about a couple of years since Mr. Henry Perigal called upon us and had a long chat, avoiding the passenger lift with scorn, instead, mounting numerous stairs to pay his visit.

OSBERT SALVIN.—Natural science has suffered a severe loss by the death of Mr. Osbert Salvin, F.R.S., F.L.S., F.Z.S., F.E.S., etc., which took place on June 1st, in his sixty-third year, at Hawksfold, near Haslemere. Mr. Osbert Salvin was educated at Westminster and Trinity Hall, Cambridge, where he graduated as Senior Optime in 1857. He is best known to ornithologists and entomologists for the magnificent work done, in connection with Mr. Frederick Godman, on the fauna of Central America. Mr. Salvin first joined in a natural history exploration of Tunis and Eastern Algeria. After a stay there of five months he proceeded to Guatemala, whither he returned a year afterwards, and again in 1861, accompanied on the latter occasion by Mr. Frederick Godman, where they stayed until 1863. In 1865 he married Miss Caroline Maitland, of Loughton, Essex. He afterwards again visited Central America. Mr. Salvin was appointed Strickland Curator in the University of Cambridge on the foundation of the office in 1874. This he held until 1883, when, on the death of his father, he moved to Hawksfold. In conjunction with his friend, Mr. Godman, he founded the magnificent work, "Biologia Centrali-Americana," a natural history of the countries between Mexico and the Isthmus of Panama, a region most richly endowed by nature. There is no doubt that this work is the finest of its character ever attempted, and has required a considerable staff of collectors and skilled naturalists continually employed in working out the material for its publication. Previous to commencing this gigantic undertaking, Mr. Salvin edited the third series of "The Ibis," of which he was one of the founders. Besides other works, we note that the list of papers standing in his name in the Royal Society's "Catalogue of Scientific Papers" reaches forty-seven, and in association with Mr. Godman or Dr. Sclater there are a further seventy-seven titles. Mr. Salvin was a man of most extensive and accurate knowledge and one who can indeed be badly spared.

LOCALITIES FOR TULIP AND MAIDENHAIR TREES.—In reply to Mr. Martin's enquiry (*ante* p. 21), there is a fine specimen of tulip-tree in the pleasure-grounds of Boldre House, near Lymington, Hants, the property of Commander Knapton, R.N.—*Helen C. Brine, Winchester.*

In this town a nice specimen of tulip-tree is in a private garden in Southern Hill. The tree, being close to the fence, is easily examined from the roadway.—*Alfd. H. Bastin, 28, New Road, Reading.*

There is a fine tulip-tree in the Hon. Mrs. Joyce's garden at St. John's Croft, Winchester. To the best of my belief, there is a maidenhair tree in Waterlow Park, Highgate Hill, London.—*Chas. J. Soltau, 5, Mornington Terrace, Portsmouth.*

In the Botanical Garden attached to University College, Bristol, there are growing two very fair specimens of *Liriodendron tulipifera* (the tulip-tree), and *Gingko biloba* or *Salisburia adiantifolia* (the maidenhair tree).—*H. Audcent, "Corazon," 3, Clifton Wood, Clifton, Bristol.*

A well-grown specimen of tulip-tree is in Maidwell Dale, Northamptonshire, and a fine avenue of them at Chatsworth. There is a specimen of maidenhair tree at the Botanical Gardens, Cambridge, and, if I remember rightly, one in the grounds of Orton Longueville, Peterborough. This is a small contribution to what, in the case of the tulip-tree at least, I should imagine would be a long list.—*H. M. Dixon, Wickham House, East Park Parade, Northampton.*

In 1876 I planted both trees in my garden at Birstal Hill, three miles north of Leicester. The tulip-tree (*Liriodendron*) has flourished, and is now about eighteen feet high, with a head twelve feet in diameter and a trunk about five inches. Frosts have never injured it, but I do not think it has bloomed yet. The maidenhair tree (*Salisburia*) has grown also, but less successfully. Frosts have frequently killed the younger twigs. It is now about ten feet high, but not more than three feet across at the widest part.—*F. T. Mott, Leicester.*

NATURAL HISTORY OF THE RIVIERA.—Could any of your readers kindly tell me through these columns of any moderate-priced book on the natural history, including geology, of the Riviera?—*Helen C. Brine, Winchester.*

ERINUS ALPINUS AT BERKELEY CASTLE.—In reply to Mr. Teesdale's query respecting the plant he has forwarded from the walls of Berkeley Castle, it is *Erinus alpinus.* Babington records it as growing freely on the old river bed near Tanfield, Yorkshire; but it is not included in the "London Catalogue of British Plants," or regarded by botanists as a truly indigenous species.—*W. M. E. Fowler, Liphook, Hants.*

ELECTRICITY AND PLANTS.—Perhaps some of your readers may be able to throw some light upon a curious phenomenon which came under my notice this week in my garden. On Monday evening, at 8.20, while looking at a red Oriental poppy, I noticed continued scintillations of a bluish colour, like the playing of summer lightning, proceeding therefrom. This continued for about half an hour, when no further trace of it could be seen. On the following night, however, a similar display took place about the same time, on which occasion I called in some of my neighbours to witness it, when no small astonishment was created by the sight.—*(Capt.) E. N. Cobbett, Belmont Road, Twickenham; June 15th, 1898.*

RANGE OF PLATYPTILIA TESSERADACTYLA.—We notice that this latest addition to the plume moths of Britain, which was identified by Mr. Barrett from specimens taken in Ireland by Mr. De Visme Kane last year, occurs in America as well as in Europe. Dr. Fernald, in his "Pterophoridae of North America" (*vide ante* p. 24) records it from Massachusetts, where it feeds on *Gnaphalium.*

PINK FLOWERS OF BUGLE.—In the little hollow through which a stream flows between steep banks to the sea, a short distance south of Runswick Bay, Yorkshire, there are growing, amidst a profusion of other wild flowers, a number of plants of the common bugle (*Ajuga reptans*). Most of them are normally coloured, but here and there are a few clusters with pink inflorescence. In the various "Floras" I have consulted, the colour of the flowers of the common bugle is invariably given as blue, no mention whatever being made of a pink form. Can any of the readers of SCIENCE-GOSSIP say if this latter variety, which has never before come under my observation, is to be found in other parts of the British Isles?—*Wm. Falconer, Slaithwaite, Huddersfield.*

HERRING LARVAE.—Mr. Matthias Dunn, of Mevagissey, contributed to the Marine Biological Station at Plymouth a curious note, which has been printed in the last issue of the Association's Journal. He says the master of the fishing-boat "Sea Belle" was sailing with a south-east wind on January 14th, about five miles south of Deadman Headland, when two miles from the shore they "fell in with masses of muddy-brown water in strings, some of which were three or four hundred yards long, and from two to seven feet wide, floating quite on the surface for miles." On these streaks pilchards were feeding ravenously and in immense numbers, roughly estimated at some sixty thousand fish. Mr. Blamey, the master of the boat, brought Mr. Dunn some of this floating matter, which proved to be young herrings in their first stage, with the yolk still large.

THECLA W-ALBUM.—Writing to the "Entomologists' Record" of 15th May last, Mr. George B. Dixon, of Leicester, describes his method of obtaining larvae and pupae of the white hairstreak butterflies. As this is a distinct advance on the old style of threshing the trees with a beating-stick, we have pleasure in annexing the idea from our contemporary. Mr. Dixon states that in the latter part of June he stands where the butterflies occur, under the lower branches of wych elm, on which the larvae feed, and examines the outer edge against the light. If the insects are on the tree there is seen what "appears to be a beetle resting on the underside of the leaf; pull down the branch with your stick and you have secured the pupa of the butterfly." The same process applies to the larvae. Mr. Dixon says, also, that it is astonishing how easily this process is conducted with a little practice; and he readily finds a score or more examples in an hour, if wanted. When the leaf is out of reach, he secures his penknife on

the top of a long stick, opens the blade at an angle of thirty degrees, and with this cuts the leaf-stalk, when, with the attached larva or pupa, it falls gently to the ground.

NOTES OF A HOME NATURALIST.—The first week in May our gardener at Shiplake brought in from our hothouse twin cucumbers. They were united from the stalk, measuring exactly sixteen inches and three-quarters in length. They were perfectly formed and only united by a quarter of an inch strip. They had grown perfectly straight, but on dividing exactly down the middle each cucumber became slightly curved on release from its twin support. Our gardener, who has had much experience, said he had never seen such an instance before. At Shiplake the dates of returning migratory birds were: swallows, April 9th; nightingale, April 14th; cuckoo, April 15th; corncrake and wryneck were heard about ten days after. The first thrush's nest with eggs I found on March 14th. Two sets of hedge-sparrows built their nests in a French lavender bush not two feet from the ground, and within half a yard apart. The eggs hatched in both instances, but a villainous cat disposed of the young birds. One of my wood owls, mentioned before (SCIENCE-GOSSIP, vol. iv. p. 299), was still living in the cedar on the lawn till May 25th, when I left home. His castings, full of mouse bones, were to be picked up below, and one morning he had evidently overladen himself with prey, for I found a whole mouse, freshly caught and dropped by him. About February 20th I took a dip in a little pool by the side of a wood, not worthy the name of a pond, and found the water alive with *Chydorus*, which I had never kept before. I took, also, some dead oak leaves and blades of dead grass from the pool, and soon perceived a number of pale yellow water-louse-like creatures. Each body was segmented, as it were, and the animals had each an air-bubble at the tail, length about a quarter of an inch. They seemed greatly to keep to the surface of the water, renewing their air-bubble supply constantly. I placed the jar in my drawing-room window and watched them carefully. They grew rapidly, turning darker each week. I was now able to perceive the body consisted of eleven segments—the alimentary canal being very visible down centre—six legs, and a pair of remarkably long antennae, with which they continually felt about. They continued to grow and gradually became darker, almost black, the segments barred with a lighter colour. On April 4th I found one had skinned entirely, the slough remaining as perfect as the insect, legs and long antennae attached as well, The same creature skinned again on April 26th, each time growing larger. After this I noticed the whole four I had left alive constantly skinning. I endeavoured to place the slough on a card, but in every case failed to place it naturally. As they grew older they often remained at the bottom of the jar, crawling about always with an air-bubble at their tails, but they would suddenly loose their hold and ascend without effort to the surface of the water, tail uppermost. They also had the power of crawling head downwards on the surface of the water. They were extremely interesting to keep, fed on the faded grass bents, and seemed in no way to interfere with the *Chydorus*. I was obliged to throw them into a ditch on leaving home. I have in vain looked in the Micrographical Dictionary and other books for a description of them. Perhaps some one will inform me as to their name?—(*Mrs.*) *Emily J. Climenson, Bournemouth.*

CONTRIBUTED BY FLORA WINSTONE.

THE VICTORIAN NATURALIST (Melbourne, May, 1898) contains some interesting notes, with two well-produced plates, by Mr. W. H. F. Hill, on "Some Victorian Case Moths." Only four species are dealt with in this number, but these are fully described both with regard to the larvae and their habits. The species are *Metura elongata*, *Entometa ignobilis*, *Clania tenuis* and *C. lewinii*. Mr. A. J. Campbell contributes an account of the large-billed shrike-robin *(Eopsaltria magnirostri)* which has recently been found among the sub-tropical scrubs of New South Wales, in addition to the coastal regions of Queensland.

LA NATURE (Paris, June 4th). M. J. Lafargue gives a history of wireless telegraphy, from the experiments made by Hertz in sound transmission, to Marconi's completed invention in 1896. Illustrations of the method of working this machine are given. M. A. Larbalétrier writes on the agricultural productions of Cuba. He also gives an analysis of the soil, which appears to have a large proportion of silica in its composition. M. Henry Chastrey describes fully, with illustrations, the nature, habits and form of the chigoe, named *Pulex penetrans* by Linée in 1767 and *Sarcopsylus penetrans* by Westwood in 1836. This troublesome little animal is found on the western coast of Africa and in South America, between latitudes 30° North and 25° South. It resembles the ordinary flea in form, and is exceedingly troublesome both to negroes and whites in penetrating the skin between the fingers and toes, causing ulcers and even gangrenes. This insect is what is familiarly known to sailors and others as the "jigger," evidently a corruption of its Spanish name. We recently illustrated the chigoe (SCIENCE-GOSSIP, N.S., vol. iv. p. 361).

COMPTES RENDUS (Paris, May 23rd). M. Berthelot contributes some of the results of his recent experiments in the oxidation of pyrogallol by free oxygen in the presence of alkalis. The characters produced vary considerably, depending largely on the nature of the alkali present. M. Edmond Perrier has in this number a long and interesting article on the "Origin of Vertebrates." By a system of inverse analogy he traces the descent of vertebrates from the Amphioxus, or a similar vertebrate source. A note on the inflammability of various combustible vapours by MM. H. Le Chatelier and O. Boudouard should be of great value, especially as it contains a table of several well-known gases, giving (1) the temperature at which they become mixed with air; (2) specific gravity per litre of the mixture at a temperature of 15°; (3) volume of vapour in 100 volumes of the mixture; (4) volume of oxygen necessary to cause combustion; (5) the quantity of heat by the combustion given forth by one molecular volume of the mixture. The results of the spectrum analysis of some minerals by a new method is given by M. A. de Gramont in a note read before the Academy of Sciences by M. Friedel.

NOTICE is given of a proclamation by the Premier of Tasmania, protecting the white-capped albatross for five years from date thereof.

IT may be some comfort to those who are liable to be bitten by a viper to know that M. C. Phisalix contributed to a recent number of "Comptes Rendus" the results of some experiments, showing that the venom of hornets acts, when injected into the veins, as an antidote against that of the vipers.

ONE of the sensations of the month is the report that an immense meteorite, said to be as big as St. Paul's Cathedral, has fallen in South Africa. If this turns out to be really the case, even that brought from Greenland by Lieut. Peary pales before the newest British visitor. It is lucky there was plenty of room where it fell.

THE last number received of the "Journal of the Essex Technical Laboratories" contains the Report, by Mr. T. S. Dymond, upon the remarkable saltwater flood of November last in Essex, when fifty thousand acres around the coast were submerged. He makes some practical suggestions for eliminating the salt left upon the soil. We imagine that it will not take long for the rainwater to carry off the greater portion; which is also his view.

THE Geological Society has, we understand, moved to secure the retention of the Museum of Practical Geology in the Jermyn Street building. This is satisfactory, and we hope the museum will remain in its old quarters. A contemporary devoted to the interests of professional science argues for its removal to South Kensington. Its reasons are hardly sufficient to convince those who think otherwise. If it is indeed a question of space, the duplicates might be sent westward and form the basis of a reference collection on the excellent lines suggested by "Natural Science."

IT is to be hoped that the hitch which has arisen relative to the new Science and Art buildings at South Kensington will be shortly overcome. The Royal Society has used its powerful influence to secure the proper provision of suitable buildings for the Science Section, in the form of a memorial to the Prime Minister fully explaining the position. We may therefore hope, with further consideration, the Treasury may see its way to revise its present unsatisfactory apportionment of the large grant for the new accommodation between the sisters Science and Art.

IT is remarkable that there are still people in this country anxious to starve science for the benefit of art. That the effect of modern art teaching and the exhibition of articles of vertu is rapidly improving the social condition of the people is evident to thinking persons. Every effort should therefore be made for its encouragement. When we consider, however, what science has done during the last half century for the prosperity, comfort, health and wealth of the nation, the time has passed for trivial arguments against the expenditure of a few hundreds of thousands of pounds of the public money for its benefit.

THIS year the months of January and June have been closely alike on certain days in temperature; not more than half a degree difference having occurred between them.

MR. ALEXANDER SOMERVILLE, of Glasgow, desires us to say that the price fourpence covers the postage and carrier-tube for his "County and Vice-County Divisions of the British Islands." In our notice of the sheet, we mentioned that the postage was three-halfpence.

THE first photographs of occultations were made by Professor G. P. Bond more than forty years since, when several plates were taken just before the occultation of α Virginis (Spica) with a view of photographically determining the position of the moon.

THE Irish Field Club Union has issued a beautifully-illustrated programme of its excursion to Kenmare, and the annual conference to be held there, from July 7th to 13th. The plan seems to be well organized, the expenses to and from Dublin, including hotel, drives, etc., for the period, being about five pounds. The party is limited to one hundred persons.

KENMARE is situated in one of the most interesting parts of Britain, lying between the Lakes of Killarney and the long estuary from the Atlantic up the Kenmare River. The region contains the home of the arbutus, the Irish-spurge, great-butterwort, and some curiously strayed but well-established American plants, such as the pipe-wort and blue-eyed grass of Canada.

AMONG the animals, too, of the Kenmare district are many of interest, not only on account of their association with the fauna of the Spanish peninsula, but also from their deviations from the usual types on account of the great mildness of the climate. Among these are a black or greyish mottled slug (*Geomalacus maculosus*) found only in one other place in the world, and that in Portugal; another is the Killarney snail, *Limnaea involuta*. The lepidoptera of the district are apt to vary strangely, probably from climatic influences.

WRITING of American plants having a foothold in Ireland reminds us that when last over in Canada, our friends Professor Saunders, F.R.S., and Mr. James Fletcher, F.L.S., drew our attention to the fact that migration of plants and of animals is almost invariably from east to west. The very limited number of plants of western origin settled in Eastern America only proves the rule.

THIS tendency to migrate from east to west, equally applies to American wildings settled in Europe. In comparison with the long and varied list of European plants which get a firm hold on the western continent, we have very few established here; even the terrible swan-weed of our canals is said to be dying out. On the other hand oxeye-daisies and the blue flowers of wild chicory make the Eastern American landscape brilliant with colour.

IT is curious, too, to watch the annnal progress of the oxeye-daisies by the side of the Grand Trunk Line of the Canadian Pacific Railway, through the great forest region north of the lakes. Each season the plants get further westward, maintaining themselves on the earth thrown up from ditches by the side of the line. When they do reach the prairies, we wonder what will happen? Something will have to disappear to make room for them.

THE SOUTH LONDON ENTOMOLOGICAL AND NATURAL HISTORY SOCIETY.—May 26th, 1898, Mr. J. W. Tutt, F.E.S., President, in the chair. Mr. Edwards exhibited two very large prawns from Madras, and also a living specimen of a scorpion found by himself in the neighbourhood of Cannes, where they were abundant; it fed readily upon young cockroaches. Mr. West, of Greenwich, a series of the smallest British water-bug, *Microvelia pygmaea*, and stated that it ran readily over the surface of the water. Mr. Turner, a life-history series of *Coleophora genistaecolella* from Carlisle, showing imagines and cases made by the larvae on the food-plant *Genista anglica* (the petty-whin); he stated that the larvae were noticed at Oxshott on May 21st, during the society's field meeting; he also exhibited a very perfect fossil specimen of Trilobite. The collection of slides circulated by the South-Eastern Union of Scientific Societies, to illustrate the Gault and Wealden formations as they appear in the south-east of England, were then shown by the lantern, and Mr. Lucas, B.A., read the accompanying descriptive lecture.—June 9th, 1898, Mr. J. W. Tutt, President, in the chair. Mr. Lucas, coloured drawings of *Libellula fulva*, showing details. Mr. Bishop, a bred specimen of *Brephos parthenias*, having a gap in the wing due to an injury to the pupa; the gap was ciliated; he also exhibited specimens of *Thecla rubi*, and remarked on the variability of the androconial marks in this species, while in all the rest of the genus they were notably constant; specimens of *Rumia luteolata*, showing considerable range of variation in the red spotting, and larvae of *Taeniocampa munda*, *T. incerta* and *T. stabilis*. Mr. Tutt, ova of *Hepialus lupulinus*, and said that under a glass they looked like black sloes. Mr. West, of Greenwich, series of the Hemiptera-Heteroptera, *Trapezonotus agrestis* and *Tropislethus holosericeus*, obtained by shaking moss in Headley Lane. Mr. Shortridge Clarke gave an account of a remarkable occurrence of thousands of larvae and imagines of *Caradrina quadripunctata* (*cubicularis*) in a large hay store in the Isle of Man.—*Hy. J. Turner, Hon. Report Sec.*

ROYAL METEOROLOGICAL SOCIETY.—The monthly meeting of this society was held on June 15th, at the rooms of the Royal Astronomical Society, Burlington House, Mr. F. C. Bayard, LL.M., President, in the chair. A paper, by Mr. R. C. Mossman, F.R.S.E., was read, on "The Frequency of Non-Instrumental Meteorological Phenomena in London with different Winds, from 1763-1897." In previous papers the author has discussed the secular and seasonal variation of various phenomena, and he now gives the results of an analysis of the direction of the surface winds observed during the occurrence of snow, hail, gales, thunderstorms lightning, fog and aurora. Snow is of most frequent occurrence with north and east winds, and least common with south-west winds. Hail showers occur most often with west, north-west and north winds. Gales are most frequent with west and south winds. The greatest number of both summer and winter thunderstorms occurs with west winds, although the values in summer are high with east, south-east and south winds. The greatest number of fogs are recorded on calm days, closely followed by days on which the wind blew from the east. A paper, by Mr. A. L. Rotch, was also read, on "The Exploration of the Free Air by means of Kites at Blue Hill Observatory, Mass., U.S.A." After giving a brief account of the use of kites for scientific purposes from 1749 to the present time, the author described the various forms of kites which have been employed at Blue Hill Observatory, viz., the Eddy, or Malay tailless kite; the Hargrave cellular, or box, kite; and the Lamson aerocurve kite. The highest flight was on October 15th, 1897, when, by means of four kites having a combined lifting surface of 150 square feet, the meteorograph at the end of 20,100 feet of wire was raised vertically 11,080 feet above the hill. About 200 records from kites have been obtained in the free air at heights from 100 to 11,000 feet in all kinds of weather. Mr. Rotch maintains that the kite can be made of the greatest importance for meteorological investigation. At the recent meeting of the International Aeronautical Committee at Strasburg it was recommended that all central observatories should employ kites, as being of prime importance for the advancement of meteorological knowledge.

CONCHOLOGICAL SOCIETY, LONDON BRANCH.—On June 4th a successful field meeting was held on Barnes Common. From two ditches the following mollusca were collected: *Sphaerium corneum*, *Pisidium fontinale*, *Segmentina nitida*, *Planorbis corneus*, *P. contortus*, *P. vortex*, *P. complanatus*, *Physa fontinalis*, *Limnaea peregra*, *L. palustris*, *Valvata cristata*, and a scalariform variety of the last-named which does not seem to have been noticed previously.—*J. E. Cooper, Hon. Sec., 68, North Hill, Highgate.*

NOTICES OF SOCIETIES.

*Ordinary meetings are marked †, excursions *; names of persons following excursions are of Conductors.*

LONDON GEOLOGICAL FIELD CLASS.—Conductor, Professor H. G. Seeley, F.R.S.

July 2.—*Sevenoaks: parallel valleys and hills of stratification. Weald to chalk.

Hon. Class Secretary (Second Series), J. W. Jarvis, St. Mark's College, Chelsea, S.W.

CONCHOLOGICAL SOCIETY, LONDON BRANCH.

July 9.—*Field Meeting at Swanley, leaving Holborn Viaduct Station at 3.15 p.m. Visitors will be welcomed.

Hon. Sec., J. E. Cooper, 68, North Hill, Highgate, N.

GEOLOGISTS' ASSOCIATION OF LONDON.

July 9.—*Isle of Sheppey, Kent. W. Whitaker, F.R.S., Pres. G.S., and T. V. Holmes, F.G.S.

„ 16.—*Warlingham, Surrey. W. Whitaker, F.R.S., Pres. G.S.

„ 28 to Aug. 3.—*Birmingham, Nuneaton, Dudley, Lickey, Cannock, etc. Prof. C. Lapworth, LL.D., F.R.S., W. W. Watts, M.A., F.G.S., W. J. Harrison, F.G.S., and W. Wickham King, F.G.S.

Sept. 10.—*Gravesend, Kent. G. E. Dibley, F.G.S.

Further particulars from *Horace W. Monckton, Hon. Sec. (Excursions), 10, King's Bench Walk, Temple, E.C.*

LINCOLNSHIRE SCIENCE SOCIETY.

July 16.—*Skellingthorpe and Doddington woods, ponds and Old Trent gravels.

Sept. 3.—*Barkstone, for Syston and Belton Parks. Rev. E. Nelson, M.A.

„ 21.—*Woodhall Spa: botany of the Moors; glacial beds.

Oct. 8.—*Torksey: Old Trent gravels. W. E. Asquith.

Hon. Sec., G. A. Grierson, F.L.S., 312, High Street, Lincoln.

NOTTINGHAM NATURAL SCIENCE RAMBLING CLUB.

Conductors of Rambles:

Geology, J. Shipman, F.G.S.; *Botany*, W. Stafford.

July 2.—*Geology. Meet at Midland Station, 1.15 p.m., for Mansfield: sandstone, etc. Fare and tea, 3s. 3d.

„ 16.—*Botany. Meet at Midland Station, 1.15 p.m., for Hucknall.

July 30.—*Geology. Meet in front of University College, Shakespeare Street, 2.30 p.m., drive to East Leake and Gotham: marls, shales, gypsum, etc. Fare and tea, 2s. 6d.; tickets to be taken before July 30.
Aug. 13.—*Botany. Meet at Emmanuel Church, Woodborough Road, 2.30 p.m., for Lambley Dumbles.
" 27.—*Geology. Meet at Sneinton Baths, 2.45 p.m., for Colwick for Bunter Pebble Beds, Keuper strata, etc.
Sept. 10.—*Botany. Meet at Lodge, Waverley Street entrance, to examine Arboretum and Pater Herbarium at University Museum.
Oct. 29.—†Annual Meeting and Exhibition, 4.15 p.m., Natural Science Laboratory, University College.
Hon. Sec., W. Bickerton, 187, Noel Street.

PRESTON SCIENTIFIC SOCIETY.
July 14.—*Grange.
" 30.—*Visit to Stonyhurst College.
Aug. 20.—*Brock Bottoms.
Sept. 8.—*Ingleton.
W. Hy. Heathcote, F.L.S., Sec., 47, Frenchwood Street.

YORKSHIRE NATURALISTS' UNION.
July 9.—*Jerveaux Abbey
" 29 to Aug. 1.—*Easington for Spurn Point.
Aug. 19.—†Annual Meeting at Scarborough.

METROPOLITAN SCIENTIFIC SOCIETIES.

The following is a list of societies in the London district devoted to natural science, with hours and places of meeting. They may be visited with introduction from a Fellow, Member, or Secretary. Will secretaries send additions or corrections.

ANTHROPOLOGICAL INSTITUTE OF GREAT BRITAIN, 3, Hanover Square. Second and fourth Tuesdays at 8.30 p.m., November to June.
BATTERSEA FIELD CLUB AND LITERARY AND SCIENTIFIC SOCIETY. Public Library, Lavender Hill, S.W. Thursdays, 8 p.m.
CITY OF LONDON COLLEGE SCIENCE SOCIETY, White Street, Moorfields, E.C. Last Wednesday in each month, October to May, 7.30 p.m.
CITY OF LONDON ENTOMOLOGICAL AND NATURAL HISTORY SOCIETY, London Institution, Finsbury Circus. First and third Tuesdays, 7.30 p.m.
CONCHOLOGICAL SOCIETY, LONDON BRANCH, St. Peter's Rectory, Walworth. Irregular meetings. Rev. J. W. Horsley, President, will answer enquiries.
CROYDON MICROSCOPICAL AND NATURAL HISTORY CLUB, Public Hall. Third Tuesdays, October to May, 8 p.m.
DULWICH SCIENTIFIC AND LITERARY ASSOCIATION. Fortnightly lectures Lordship Lane Hall, second and fourth Mondays, 8.15 p.m., from October, for winter season.
EALING NATURAL SCIENCE AND MICROSCOPICAL SOCIETY. Victoria Hall, Ealing. Second and last Saturdays. October to May, 8 p.m.
ENTOMOLOGICAL SOCIETY, 11, Chandos Street, Cavendish Square. First Wednesday, October to June (except January). Third Wednesday, January, February, March and November, 8 p.m.
GEOLOGISTS' ASSOCIATION, University College, Gower Street. First Friday, 8 p.m., November to July.
GEOLOGICAL SOCIETY OF LONDON, Burlington House, Piccadilly. First and third Wednesdays, 8 p.m., November to June.
GREENHITHE NATURALISTS' AND ARCHÆOLOGICAL SOCIETY, 7, The Terrace. First Fridays, 7 p.m.
LAMBETH FIELD CLUB AND SCIENTIFIC SOCIETY, St. Mary Newington Schools, Newington Butts, S.E. First Mondays all the year and third Mondays in winter, 8 p.m.
LINNEAN SOCIETY OF LONDON, Burlington House, Piccadilly. First and third Thursdays at 8 p.m., November to June.
LONDON AMATEUR SCIENTIFIC SOCIETY, Memorial Hall, Farringdon Street, E.C. Fourth Friday in each month, October to May, 7.30 p.m.
LUBBOCK FIELD CLUB. Working Men's College, Great Ormond Street, Bloomsbury, W.C. Excursions second Sundays, Meetings following Mondays, 8 pm.
MALACOLOGICAL SOCIETY OF LONDON, meets in Linnean Society's Rooms, Burlington House. Second Friday each month, November to June, 8 p.m.
MINERALOGICAL SOCIETY. Meets in rooms of Geological Society, February 4th, April 14th, June 23rd, November 17th, 8 p.m.
NONPAREIL ENTOMOLOGICAL AND NATURAL HISTORY SOCIETY, 99, Mansfield Street, Kingsland Road, N.E. First and third Thursdays, 8 p.m.
NORTH KENT NATURAL HISTORY AND SCIENTIFIC SOCIETY. St. John's Schools, Wellington Street, Woolwich. Alternate Wednesdays, 7.30 p.m.
NORTH LONDON NATURAL HISTORY SOCIETY, North-East London Institution, Hackney Downs Station. First and third Thursdays, 7.45 p.m.
QUEKETT MICROSCOPICAL CLUB, 20, Hanover Square. First and third Fridays, 8 p.m.
ROYAL BOTANIC SOCIETY OF LONDON, Regent's Park. Second and fourth Saturdays at 3 45 p.m.
ROYAL HORTICULTURAL SOCIETY, 117, Victoria Street, S.W. Second and fourth Tuesdays, except December to February; 2 p.m. on show days, which vary.
ROYAL METEOROLOGICAL SOCIETY, 22, Great George Street, Westminster. 3rd Wednesday, November to June, 8 p.m.
ROYAL MICROSCOPICAL SOCIETY, 20, Hanover Square. Third Wednesdays, October to June, 8 p.m.
SELBORNE SOCIETY, 20, Hanover Square. No winter meetings.
SIDCUP LITERARY AND SCIENTIFIC SOCIETY, Public Hall, Sidcup. First and third Tuesdays, October to May, 8 p.m.
SOUTH LONDON ENTOMOLOGICAL AND NATURAL HISTORY SOCIETY, Hibernia Chambers, London Bridge, S.E. Second and fourth Thursdays, 8 p.m.
SUTTON SCIENTIFIC AND LITERARY SOCIETY, Public Hall Chambers. Second and forth Tuesdays, 8 p.m.
WEST KENT NATURAL HISTORY, MICROSCOPICAL AND PHOTOGRAPHIC SOCIETY. Meets in School for Sons of Missionaries, Blackheath, third Wednesday, in December, fourth Wednesdays in October, November, January, February, March, April, May, 8 p.m.
ZOOLOGICAL SOCIETY OF LONDON, 3, Hanover Square. First and third Tuesdays, 8.30 p.m., November to August.

NOTICES TO CORRESPONDENTS.

TO CORRESPONDENTS AND EXCHANGERS.—SCIENCE-GOSSIP is published on the 25th of each month. All notes or other communications should reach us not later than the 18th of the month for insertion in the following number. No communications can be inserted or noticed without full name and address of writer. Notices of changes of address admitted free.

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Strictly Editorial communications, *i.e.*, such as relate to articles, books for review, instruments for notice, specimens for identification, etc., to be addressed to JOHN T. CARRINGTON, 1, Northumberland Avenue, London, W.C.

NOTICE.—Contributors are requested to strictly observe the following rules. All contributions must be *clearly* written on one side of the paper only. Words intended to be printed in *italics* should be marked under with a single line. Generic names must be given in full, excepting where used immediately before. Capitals may only be used for generic, and not specific names. Scientific names and names of places to be written in round hand.

THE Editor will be pleased to answer questions and name specimens through the Correspondence column of the magazine. Specimens, in good condition, of not more than three species to be sent at one time, *carriage paid*. Duplicates only to be sent, which will not be returned. The specimens must have identifying numbers attached, together with locality, date and particulars of capture.

THE Editor is not responsible for unused MSS., neither can he undertake to return them, unless accompanied with stamps for return postage.

EXCHANGES.

NOTICE.—Exchanges extending to thirty words (including name and address) admitted free, but additional words must be prepaid at the rate of threepence for every seven words or less.

MINERALS.—Fine specimens of minerals and fossils offered in exchange for British or foreign marine shells.—P. J. Roberts, 11, Back Ash Street, Bacup.

OFFERED, large collection of foreign marine and land shells in exchange for land species not in collection. Please state genera required.—Miss Linter, Saville House, Twickenham.

MICROSCOPE, by Browning, Strand. What offers?—G. Proctor, 44, Ampthill Square, London, N.W.

TWELVE dozen professionally prepared microscopic slides, chiefly botanical, mosses, ferns, algae, cryptogamia, etc. Wanted, ½-objective or photomicrographic apparatus.—Walter Pindar, Wyggeston Street, Burton-on-Trent.

WANTED, "Jones' Set" of 72 pathological slides, with reference list, mentioned in Wright's "Popular Hand-book, Microscopy." Would exchange "Naturalist's Library," bound half-calf. 36 volumes out of the set of 40 volumes: 12 "Mammalia," vols. i. to xiii., No. 10 missing; 12 "Ornithology," vols. i. to xiv., Nos. 1 and 2 missing; 6 "Entomology," vols. i. to vii., No. 5 missing; 6 "Ichthyology," vols. i. to vi., perfect.—John J. Gilgeous, Homœopathic Dispensary, 10, Albert Street, Oldham.

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To whom all business communications should be addressed